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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 May 2002 (02.05.2002)

PCT

(10) International Publication Number
WO 02/35026 A1

(51) International Patent Classification[7]: E04B 2/16, 5/10, 1/14, E04C 2/28, E04H 17/16

(21) International Application Number: PCT/AU01/01375

(22) International Filing Date: 9 October 2001 (09.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PR 0627 10 October 2000 (10.10.2000) AU

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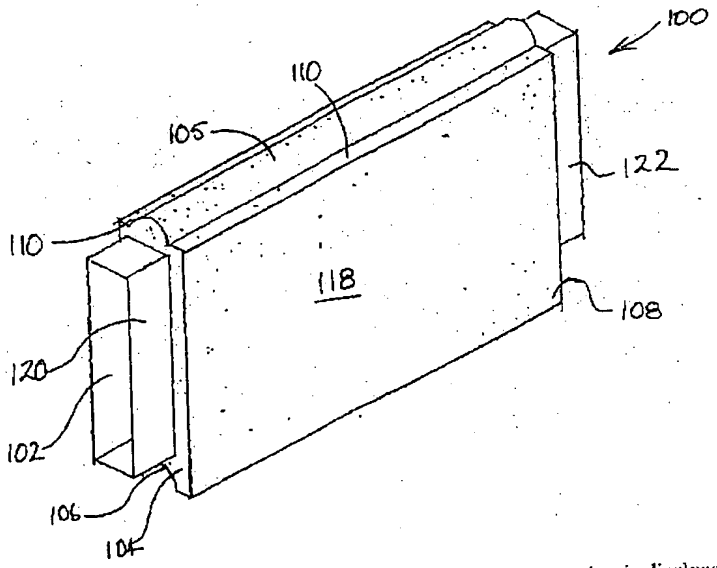
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: CONSTRUCTIONAL ELEMENT, BUILDING SYSTEM AND METHOD OF CONSTRUCTION




(57) Abstract: A constructional element (100), building system and method of construction is disclosed. The building system and method of construction utilise the constructional element (100). The construction element (100) is elongate and includes a hollow structural member (102) and cladding (104) formed about at least part of the structural member (102). Abutment means (107, 108) are formed in at least part of the cladding's (104) perimeter for mutual abutment and alignment with abutment means (107, 108) on an adjacent constructional element (100). At least one end (120, 122) of the structural member (102) protrudes from the cladding (104). A building system and method of construction are also disclosed, both of which utilise the constructional element (100).

WO 02/35026 A1

# CONSTRUCTIONAL ELEMENT, BUILDING SYSTEM AND METHOD OF CONSTRUCTION

## FIELD OF THE INVENTION

The present invention relates to constructional elements, construction systems and methods of construction.

## DESCRIPTION OF THE PRIOR ART

Building systems in the form of prefabricated modular building systems have a tendency to rely upon heavy machinery for their construction, are generally labour intensive requiring may different trades persons and although being modular require the separate construction and application of external and internal finishes. An example of components of a prefabricated modular building systems is aluminium cladding. Such cladding is typically positioned and fixedly located on the exterior of a fibre panel or wood panel building structure.

Another example of modular elements for building systems includes a system comprising end posts and concrete slabs attached therebetween. These slabs may then be rendered or coated as necessary once the building is constructed.

## SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a constructional element including:

a structural member;

cladding formed about at least part of the structural member; and

abutment means formed in at least part of the cladding's perimeter for mutual abutment and alignment

with abutment means on an adjacent constructional element.

Advantageously, the configuration of the invention allows for a constructional element which includes pre-finished cladding such that once, for example, a wall is constructed from several constructional elements there is no need to further clad, render, etc the constructed wall. This applies whether the wall is a sidewall, floor, roof, ceiling, etc.

Preferably, the constructional element may act as a load-bearing member.

Preferably the element is elongate, and the structural member includes an end which protrudes from the cladding. Preferably the structural member is hollow.

Preferably the end is adapted to seat in a channel of a C-section support element. If the constructional element is configured such that it includes an end and an opposite end protruding from the cladding, the constructional element may be secured between two C-section support elements.

Alternatively, the end is adapted to seat and is fixable in an internal corner of an L-section support element.

Preferably the connection means are formed in opposing sides of the cladding. The connection means may include a tongue formed in one said side of the cladding and a groove formed in an opposing said side. Alternatively, the connection means may include complementary step formations. The connection means aid in seating one constructional element immediately adjacent another.

Preferably, the core is rectangular in lateral cross section. Preferably the core is metallic, fibreglass, or carbon fibre.

Preferably the cladding includes cement, concrete, fibre cement, fibreglass, or cellulose. The cellulose may be derived from recycled paper.

According to a second aspect of the invention there is provided a method of construction including forming a wall by placing two or more constructional elements according to the first aspect of the invention in parallel relationship whereby the connections means on adjacent constructional elements mutually abut and align with one another.

Advantageously, the configuration of the constructional elements allows for improved construction of a panel or wall for use as a sidewall, floor, retaining wall, etc.

Preferably the constructional elements are held in parallel relationship by two support elements at respective ends of the constructional elements. Preferably the ends of the constructional elements are secured to the support elements once the constructional elements are in a predetermined position.

Preferably the support elements are elongate and C-shaped in lateral cross section.

Preferably the support elements are fixed to one another by intermediate brace elements.

According to another aspect of the present invention there is provided a building system including:

at least two spaced apart end supports; and

two or more constructional elements according to the first aspect of the invention,

wherein the first and second ends of the constructional elements are engageable with respective end supports, and arrangeable in a vertical relationship to each other to form a wall portion.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figures 1a-c are perspective side and end views of a preferred embodiment of a constructional element according to the present invention;

Figures 2a-c and 3a-c illustrate alternative arrangements of the abutment means of the structural element illustrated in Figures 1a-c;

Figures 4, 5 and 6 are perspective views of the element illustrated in Figure 1a, showing variations in the cladding;

Figures 7, 8, 10, 12, 15, 16, 19 to 21, 23 to 26, 35 and 36 illustrate complete and partial views of various constructional elements and components of a building system according to an embodiment of the present invention, in use;

Figure 9 is a perspective view of several components of the building system, illustrating the constructional element with a portion of the cladding cut away;

Figures 13a-k illustrate components of a building system according to the present invention;

Figures 14a-h illustrate several of the components of Figures 13a-k in use;

Figures 17a-b are an alternative embodiment of the constructional element including two cores;

Figure 18a is an alternative embodiment of the embodiment illustrated in Figures 17a-b, where the ends do not protrude from the cladding;

Figure 18b illustrates the embodiment of the constructional element illustrated in Figure 18a showing the cores filled with insulating material;

Figure 22 is a perspective view of the constructional element illustrated in Figure 1a, with a power point connected thereto;

Figures 27 to 34 are perspective views of various embodiments of quoins and post covers for use with the building system according to the present invention; and

Figures 37 and 38 are perspective views of alternative embodiments of a method of construction according to the present invention.

In the Figures, like reference numerals denote like parts.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the Figures, a preferred embodiment of the invention is a constructional element in the form of an elongate board 100. The board can be made in any desired length, depending on the desired function or end use of the board 100. However, the board is usually manufactured in several lengths up to a preferred length of 3.6m. The board 100 includes a structural member in the form of a hollow closed sectioned core 102. The core 102 is typically manufactured from steel though alternatively may be manufactured from alluminium, carbon fibre, fibre glass, or any other suitable structural material.

Cladding 104 is formed about at least part of the core 102. The cladding 104 is usually a cement based material such as fibre cement, though alternatively may be constructed from fibre glass; ceramics; foamed polymeric materials such as polystyrene; or cellulose based material, such as recycled paper or wood pulp; etc. The type of material used to form the cladding 104 will depend on the desired look of the finished product. For example,

if a sandstone look is desired, the cladding may be formed from glass reinforced modified cement.

Abutment means in the form of corresponding tongue 105 and groove 106 formations are formed in respective first and second opposing longitudinal edge portions 107 and 108 of the board 100. Two variations of the tongue 105 and groove 106 formations are illustrated in Figures 1a-1c and Figures 2a-2c, for example. The tongue 105 and groove and 106 formations allow for mutual abutment and alignment on and with adjacent boards 100. An example of this alignment and abutment is illustrated in Figures 1c & 2c.

The height of the tongue 105 is smaller than the depth of the groove 106, defining a gap 109 between the tongue 105 and groove 106 when adjacent boards 100 are mutually abutted and aligned. This serves two purposes. Firstly, the gap 109 allows for accommodation of a control joint between the tongue 105 and groove 106. The control joint is usually a rubber strip, or silicon tube, for example. Secondly, in practice the gap 109 allows for seating of tongue shoulders 110 directly on groove shoulders 112, to ensure there is no gap between the respective abutted shoulders 110 & 112. This improves reduction of acoustic, heat and water transfer through the join between adjacent mutually abutted and aligned boards 100.

Alternative embodiments of the abutment means are illustrated in Figures 3a-3c where the abutment means are in the form of corresponding step, or shiplap formations 114 and 116.

First and second opposing faces 117 and 118 are also formed in the cladding 104, typically in a flat arrangement. In alternative embodiments, one or both of

the faces 117 and 118 are formed in different aesthetic shapes. Examples of such alternative embodiments are illustrated in Figures 4 to 6, where face 118 is shaped for aesthetic purposes. The thickness of the faces 117 and 118 of the cladding 104 about the core 102 is usually about 10mm, though may be about 3mm in some applications. The depth of the faces 117 and 118 is usually 300mm.

The first and second ends 120 and 122 of the core 102 extend beyond the cladding 104. This is to allow the ends 120 and 122 of the board 100 to seat in a channel 124 of a C-section support element 126. This arrangement allows for a plurality of boards to be held in mutual abutment and alignment, as illustrated in Figure 7 for example.

In an alternative embodiment of the board 100, the first and second ends 120 and 122 of the board are flush with the first and second respective ends 128 and 130 of the cladding 104.

The board 100 can be used in a building system including any one of retaining walls, multi walled buildings, etc. The board 100 in such a system can be used for construction of walls in the form of sidewalls 131, or portions thereof, internal partitions, floors 132, ceilings 133, roofs 134 etc.

In one embodiment, to build a wall using a plurality of boards 100, two C-sectional support elements 126 are fixed in an upright position relative to the ground in concrete pillars 135 which are set into the ground. The C-section support elements 126 are arranged such that their respective channels 124 face towards each other. The C-section support elements 126 are spaced apart at a predetermined distance, being approximately the width of the required wall. A standard wall width is 3.6m, for example. With the width of the wall determined and C-

section support elements 126 in position, appropriate boards 100 are selected to build the desired wall, where the distance between the first and second cladding ends 128 and 130 of the plurality of boards 100 to the fitted between the elements 126 is approximately the distance between the C-section support elements 126.

As illustrated in Figure 8, a board 100 is then placed between the C-section support elements wherein the first and second ends 120 and 122 of the core 102 are fitted and fixed within respective channels 124. Figure 9 illustrates in detail how an end 120 fits within the channel 124 of a C-section support element 126. More boards 100 are then fitted and fixed between the C-section support elements 126 on top of one another wherein immediately adjacent first and second sides 107 and 108 of immediately adjacent boards 100 mutually abut. This described arrangement can be used for building a single sidewall, such as a retaining wall.

In a method for construction of, for example, a building, a plurality of side walls 131, floors 132, ceilings 132 and roof 134, and so on are erected. In this embodiment, either concrete pillars 135 or a concrete slab 136 is typically laid, upon which support posts 137 are vertically erected, as illustrated in Figures 8 or 10, for example. Main horizontal beams 138 are then attached between two support posts 137, and subsidiary horizontal beams 139 are attached between main horizontal beams 138.

As illustrated in Figure 11, for example, main and subsidiary beams 138 and 139 used for supporting a roof structure 134 are typically trapezoidal in cross section to allow for a pitched roof. Figure 12 illustrates in detail one way in which the main horizontal beam 138 is connected to a support post 137. Figures 13a to 13k

illustrate various connection means 140 for connecting main horizontal beams 138 to support posts 137 and support posts 137 to concrete slabs 136. Figures 14a to 14h illustrate several of the connection means 140 in use in supporting main horizontal beams 138 on support posts 137 and support posts on concrete slabs 136 or pillars 135.

Once the support posts 137, main and subsidiary horizontal beams 138 and 139 are in place, C-section support elements 126 are then attached in desired locations on the support posts, completing a framework super structure suitable for receiving boards 100. In an alternative embodiment, the elements 126 are attached to the support posts 137 prior to the support posts being erected on the concrete slab 136.

Where a slab 136 is used, and is therefore in direct contact with the ground, damp course, or weatherproof flashing is placed between the slab 136 and the boards 100 which directly abut the slab.

As illustrated in Figure 15, once the first end 120 of a given board 100 is in a predetermined position in a channel 124, the end 120 of the board 100 may be secured to the C-section support element 126 by crimping a portion 142 of the C-section support element inwardly to at the same time crimp a portion of the first end 120 of the board 100. This secures the board 100 in position on the support element 126. Alternatively, a hole and thread forming screw such as a TECHSCREW is employed to screw directly through a wall of the C-section support element 126, and the first or second end, 120 or 122 engaged within the C-section support element 126, to secure the first or second end on the C-section support element.

In an alternative embodiment, holes 144 may be preformed within the first and second ends 120 and 122,

and a securing means such as a screw, bolt, nail, etc placed through corresponding holes 144 in the first or second end and 122 of the board and preformed holes 146 in the C-section support element 126.

Also, as illustrated in Figures 8 and 16, a plurality of boards 100 may be used to form a floor 132 within the building system. In one embodiment, the boards 100 used to form the floor 132 include one core 102, for example as illustrated in Figures 1a to 1f, or alternatively, for added load bearing support, boards 100 used for the floor 132 may include twin cores 102, as illustrated in Figures 17a, 17b, 18a and 18b. Figure 19, for example, illustrates the boards of Figures 18a and 18b in a floor 132 configuration. In the preferred embodiment of the invention, the ends 120 and 122 of the cores 102 of the boards 100 used to construct floors 132 do not protrude from the respective ends 128 and 130 of the cladding 104. This is illustrated in Figures 19 to 21, for example. This is so the ends 120 and 122 of the cladding 104 are flush with an adjacent wall 131. Also, as illustrated in Figure 20, individual boards 100 when part of a floor 132, are typically secured to a respective main horizontal beam 138 by a mounting bracket 156. A lining strip in the form of a control/expansion joint 158, typically formed from rubber or polymer, is placed between the floor 132 or roof 134 and main horizontal beam 138. A ceiling 133 or roof 134 is constructed in an identical manner as described in relation to construction of floor 132. If the length of board 100 used to construct a floor 132 or ceiling 133 is a standard length of 3.6m or less, subsidiary beams 139 are not required.

Aside from load bearing properties of the hollow core 102, the hollow nature of the core 102 allows for running

of electrical services 152 through resultant walls 131, floors 132, etc, as illustrated in Figure 20. The hollow support posts 137 and main and subsidiary horizontal beams 138 and 139 also allow for running of electrical services, which may be continued through the walls, floors, etc or connected to electrical services therein. The electrical services can then be connected to powerpoints 154 connected to a board 100 in a desired location, as illustrated in Figure 22. It will be clear to a person skilled in the art that the cores 102, posts 137, etc, also allow for running through of water, telephone and gas services, and ducting for air conditioning. In the case of air conditioning, this could be used to either heat or cool side walls 131, floors 132, or ceiling 133, or to direct hot or cold air to an outlet to blow the air into a predetermined room, for example.

The hollow nature of the cores 102 also allows for insulating material 160 to be placed therein, as illustrated in Figure 18a. The insulating material 160 is typically foam, though alternatively may be paper based, wool based, or made from any other suitable insulating material.

Once floors 132, side walls 131, roofs 134 and ceilings 133 have been constructed, quoins 164 and post covers 166 are positioned on the building, for example as illustrated in Figures 23 to 26. Both quoins 164 and covers 166 are typically connected to their respective support posts 137 by bolting attachment plates 168 to the posts 137. In the embodiments of the quoins 164 and post covers 166 where the attachment plates are flat (Figures 27 to 31), a second quoin 164 or cover 166, as appropriate, is positioned above the first attached quoin 164 or cover 166 such that the exposed portion 170 of the

plate 168 of the attached quoin or cover is covered by a recess 172 in the next quoin 164 or cover 166.

In alternative embodiments of the quoins 164 and post covers 166 illustrated in Figures 32 to 34, the attachment plates include a step portion 174, and bottom extending portion 176. In these embodiments, when a second quoin 164 or cover 166, as appropriate, is positioned above the first attached quoin 164 or cover 166, the step portion 174 is located in the recess 172 between the bottom extending portion 176 and main body 178 of the quoin 164 or cover 166.

In another alternative embodiment illustrated in Figure 35, a corner 178 is formed directly on to the corner of the building, typically from a cement based material. In another alternative embodiment, illustrated in Figure 36, an end 180 of the boards 100 are cut or formed at a 45° angle to form a building corner with another like board positioned end to end to that board 100.

Figure 36 illustrate how C-section elements 126 are used in part to form window 181 and door 182 vertical frame portions. Also, an alternative embodiment of the board 100 illustrated in Figures 6 and 36 is used directly above windows 181 and doors 182, which includes a thickened cladding portion 183 and a drip groove 184. The thickened cladding portion 183 is both aesthetic and bears the drip groove 184. If water, such as from rain, runs down this board 100, the thickened cladding portion 183 aids in directing the water away from the window 181 or door 182, and the drip groove 184 aids in preventing water from running transversely along the underside 185 of the board 100 and into the building. Weatherproof flashing 187 is also placed between the window or door frame and

the board 100 directly above the window or door frame and between the board 100 directly below the window frame.

The embodiment of the board 100 illustrated in Figure 5 is usually used as the uppermost board 100 in a side wall 131, being the board 100 directly under the roof 134.

Figure 37 illustrates another alternative embodiment for forming a side wall 131, where the side wall 131 is pre-assembled by placing C-section support elements 126 directly onto respective ends 120 and 122 of exposed core 102. The preformed wall 131 is then placed in position on a building frame structure, which includes L-section support elements 186. The C-section support elements 126 are then abutted against their respective L-section support elements 186, and secured in place.

In an alternative embodiment of the embodiment illustrated in Figure 37, the boards 100 are assembled and secured directly onto L-section support elements 186. This is achieved by securing respective ends 120 and 122 of individual boards 100 directly into internal corners of the L-section support elements 186.

Figure 38 illustrates another alternative embodiment for forming a side wall 131, where a recess 188 is formed in the cladding 102 of one face 118 of the boards 100 to accommodate the adjacent support posts 137. The board 100 is then attached to the support post 137 by a screw or the like, which couples between the support post 137 and the core 102. In this embodiment, post covers 166 are not required. Also in this embodiment, quoins 164 are also not required.

Now that preferred embodiments of the invention have been described, it will be apparent to those skilled in the art that the constructional element, method of construction and building system has at least the

following advantages:

1 they offer a cheaper alternative to standard building methods;

2 the hollow nature of the constructional element acts as an acoustic dampener, and insulator;

3 the resultant building structure has high structural integrity, since each constructional element is connected to the superstructure;

4 they allow for a relatively inexpensive kit building system which allows for building of an aesthetic building; and

5 the resultant building, retaining wall, etc, is relatively easy to install, being able to be assembled without the use of heavy machinery, and with reduced tradespeople activity.

Although the invention has been described with reference to particular examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A constructional element including:

a structural member;

cladding formed about at least part of the structural member; and

abutment means formed in at least part of the cladding's perimeter for mutual abutment and alignment with abutment means on an adjacent constructional element.

2. A constructional element according to claim 1, wherein the structural member is elongate and at least one end protrudes from the cladding.

3. A constructional element according to claim 1 or 2 wherein the structural member is hollow.

4. A constructional element according to claim 2 or 3 wherein said at least one end is adapted to seat in a channel of a C-section support element.

5. A constructional element according to claim 2 or 3 wherein said at least one end is adapted to seat and is fixable in an internal corner of an L-section support element.

6. A constructional element according to any one of claims 2 to 5 wherein the cladding is elongate and the abutment means are formed in opposing longitudinal edge portions of the cladding.

7. A constructional element according to claim 6 wherein the abutment means include a tongue and a groove formed in respective of said opposing edge portions.

8. A constructional element according to claim 6 wherein the abutment means include complementary step formations.

9. A constructional element according to any one of the preceding claims wherein the structural member is shaped rectangular in transverse cross section.

10. A constructional element according to any one of the preceding claims wherein the structural member is metallic, fibreglass, or carbon fibre.

11. A constructional element according to any one of the preceding claims wherein the cladding includes cement, concrete, fibre cement, fibreglass, or cellulose.

12. A constructional element according to any one of the preceding claims wherein the structural member is one of a pair of structural members wherein the cladding is formed about both of said members.

13. A method of panel construction including:

providing a plurality of constructional elements to form the panel, the constructional elements including:

a structural member;

cladding formed about at least part of the structural member; and

abutment means formed in at least part of the cladding's perimeter for mutual abutment and alignment with abutment means on an adjacent constructional element; and

mounting the constructional elements alongside one another such that the abutment means align, and adjacent construction elements together form the panel.

14. A method of construction according to claim 13 wherein the constructional elements are held in parallel relationship by two support elements at respective ends of the constructional elements.

15. A building system including:

at least two spaced apart end supports; and

two or more constructional elements including:

a structural member;

cladding formed about at least part of the

structural member; and

abutment means formed in at least part of the cladding's perimeter for mutual abutment and alignment with abutment means on an adjacent constructional element,

wherein first and second opposing ends of the constructional elements are engageable with respective end supports, and arrangeable in a vertical relationship to each other to form a wall portion.

16. A building system according to claim 15 wherein the end supports include a channel for receiving one of the first and second ends of the constructional elements.

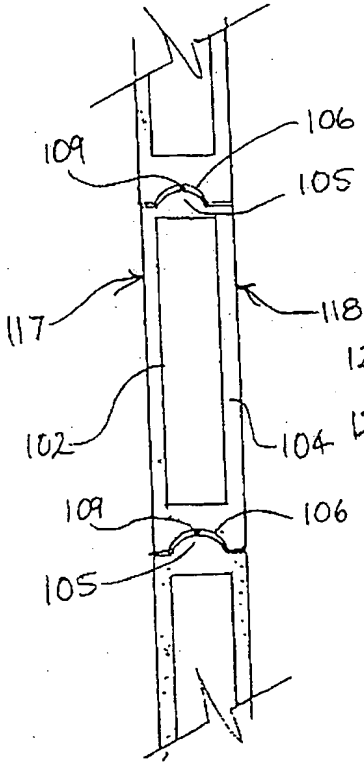



FIG. 1c

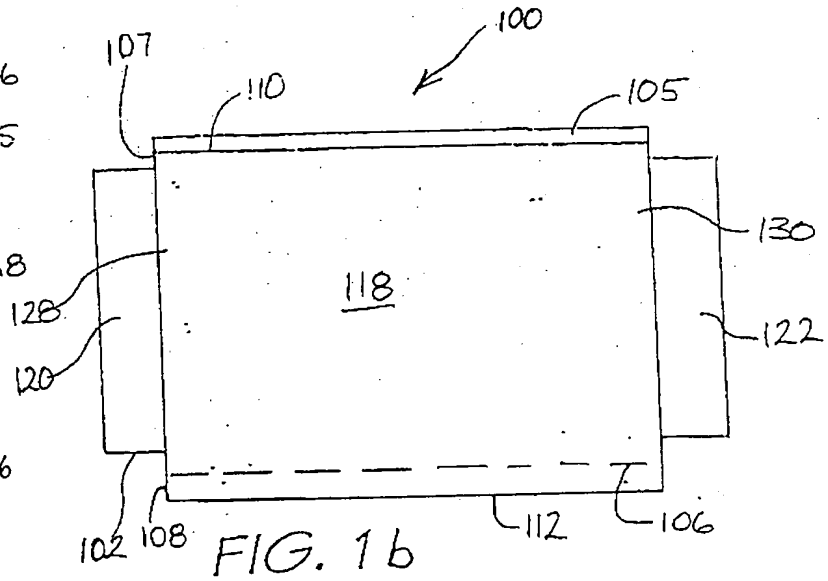



FIG. 1b

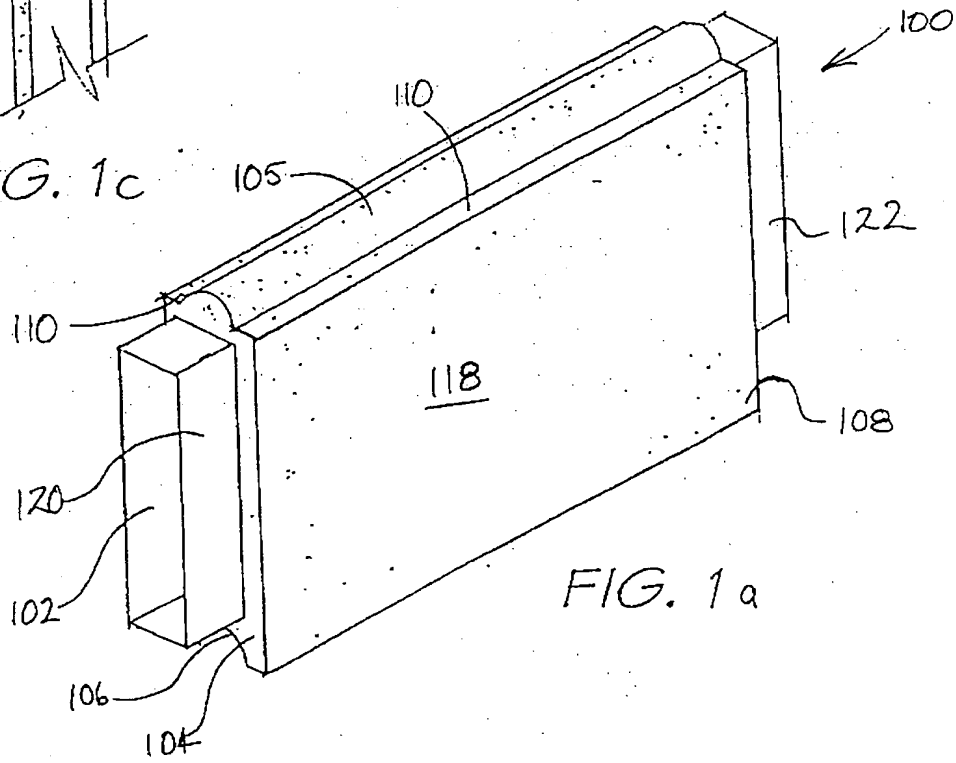



FIG. 1a

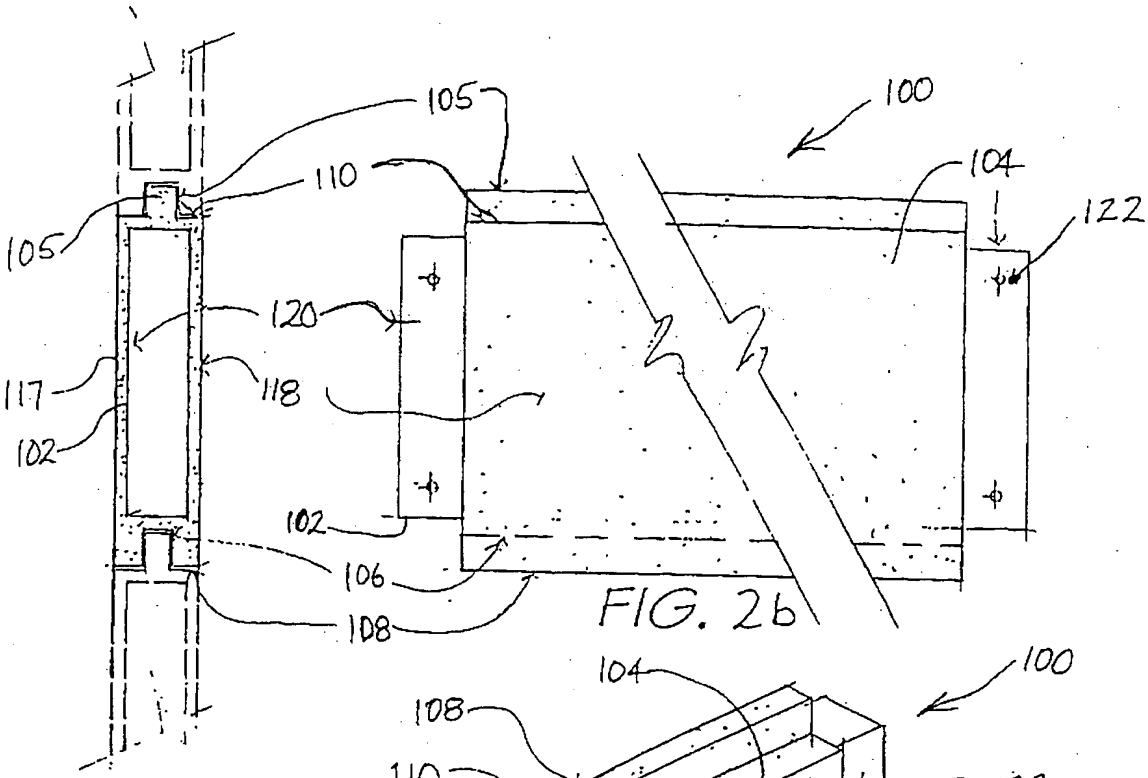



FIG. 2b

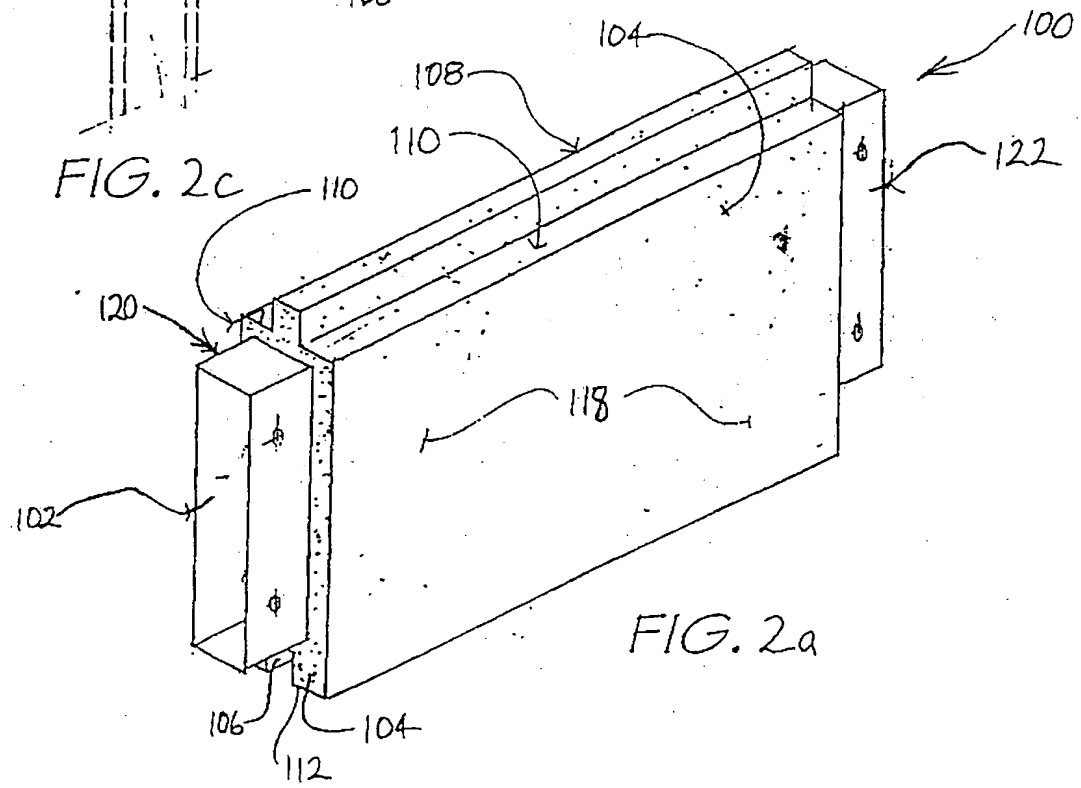



FIG. 2c

FIG. 2a

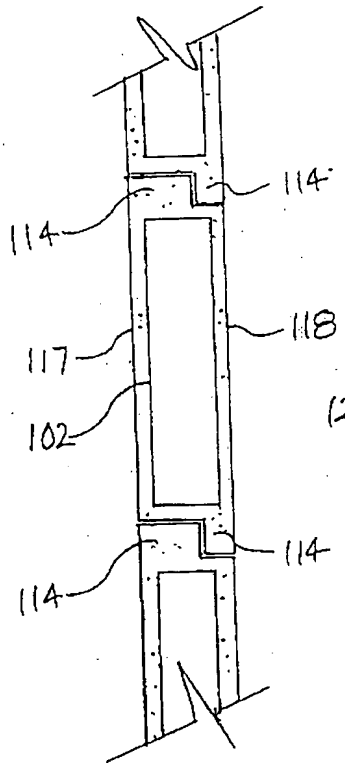



FIG. 3c

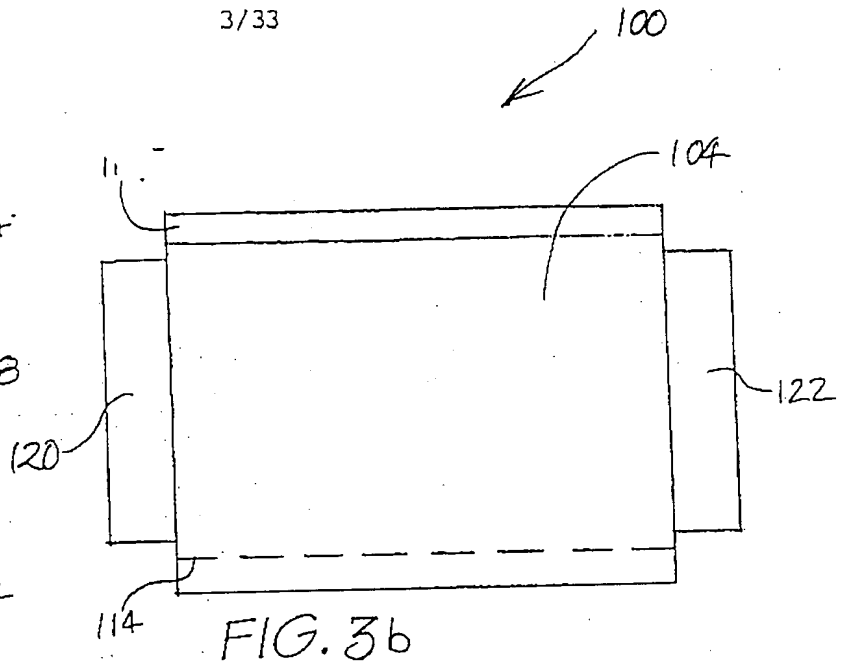



FIG. 3b

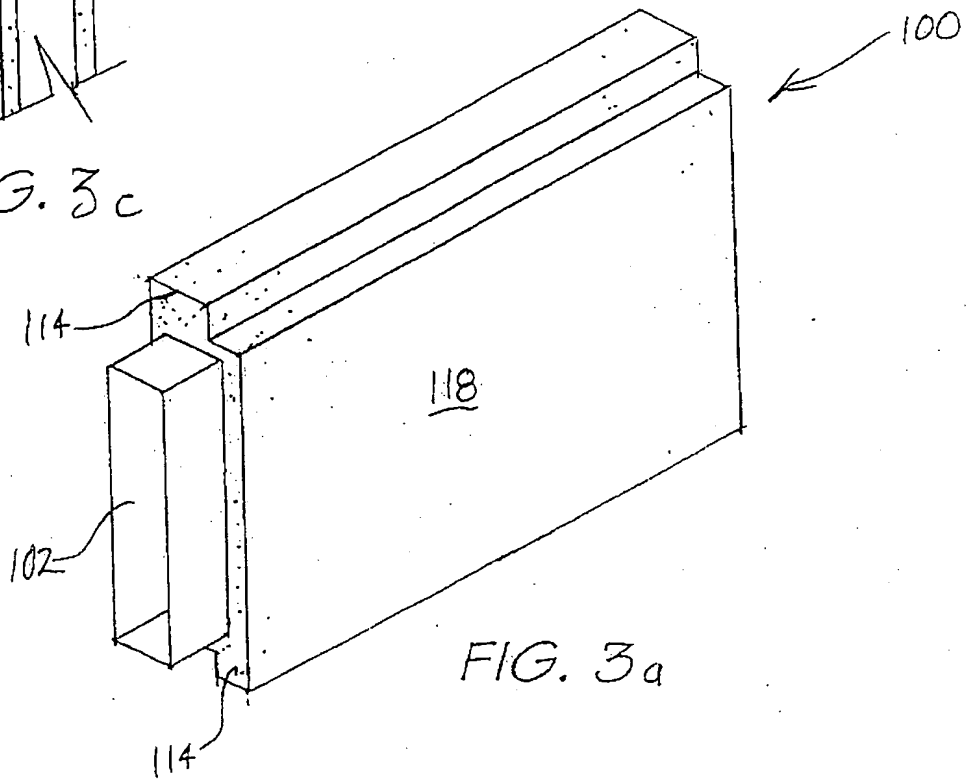
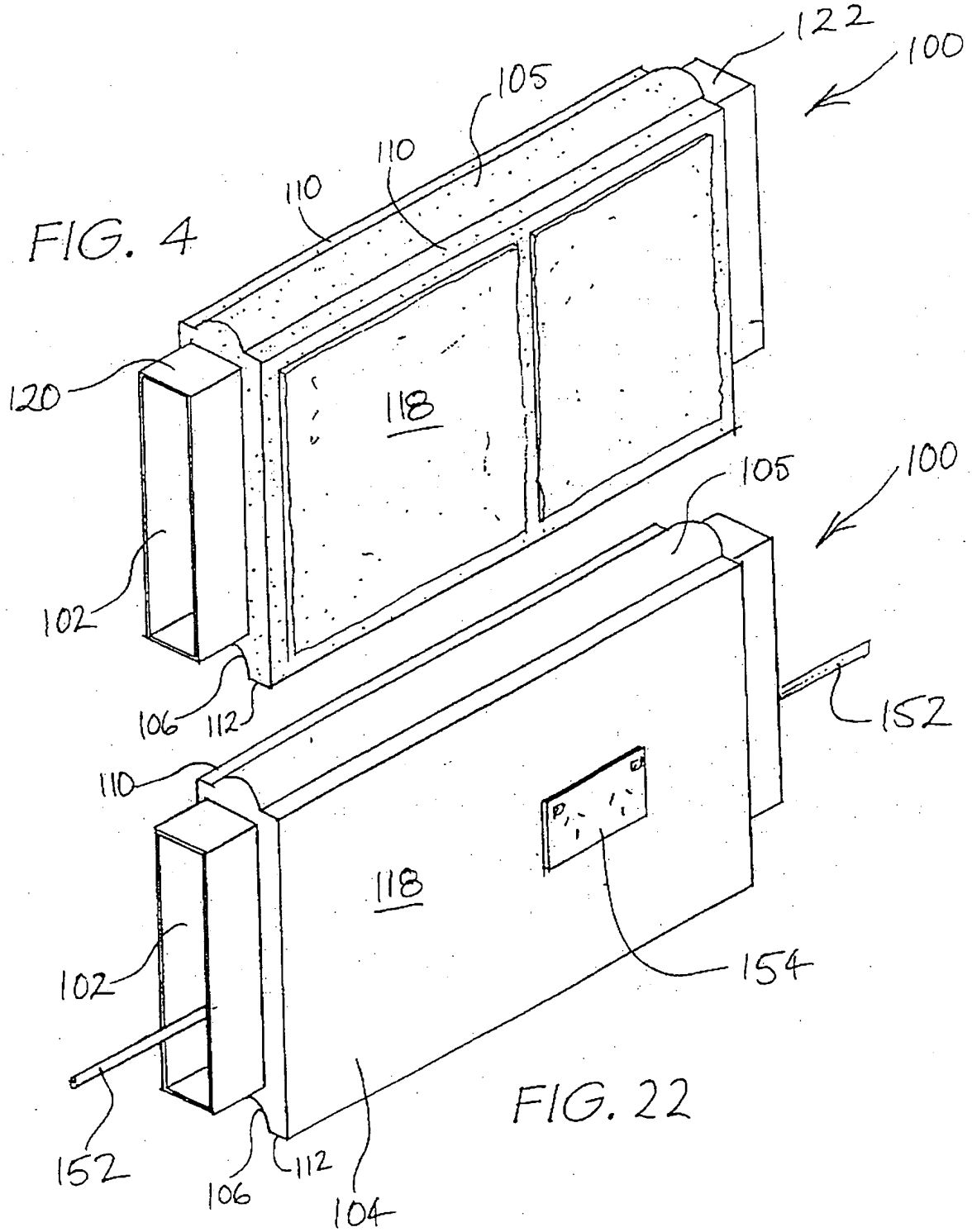



FIG. 3a

FIG. 4


122
100
105
110
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120
118
102
106
112
105
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152
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118
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154
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106
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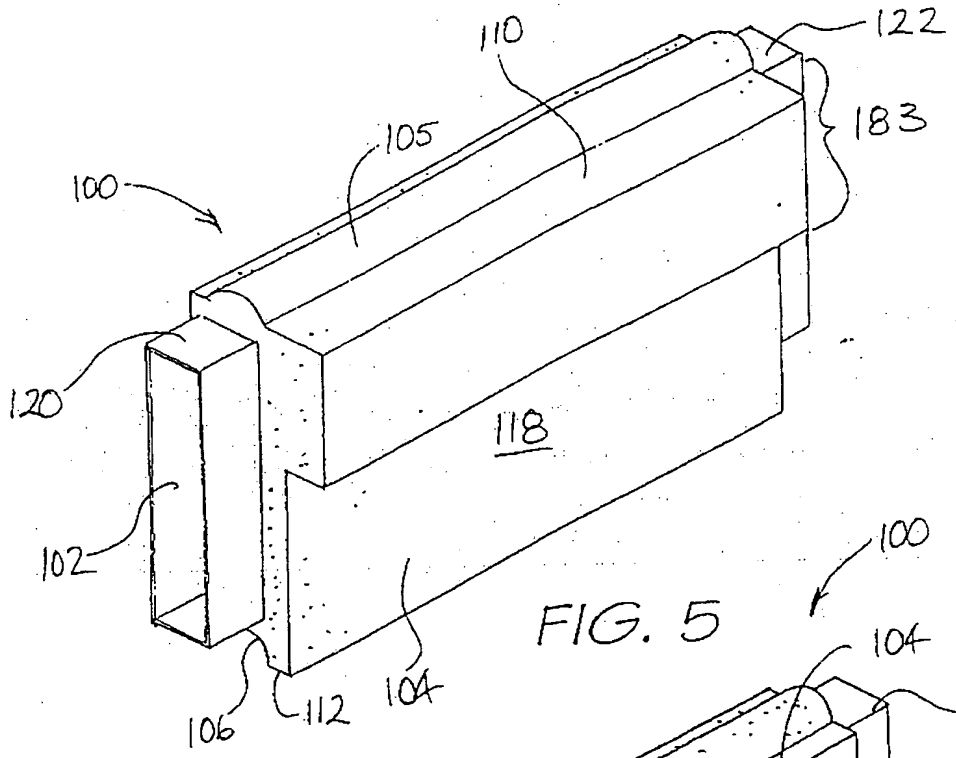
104

FIG. 22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122
183
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118
102
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106
112

FIG. 5

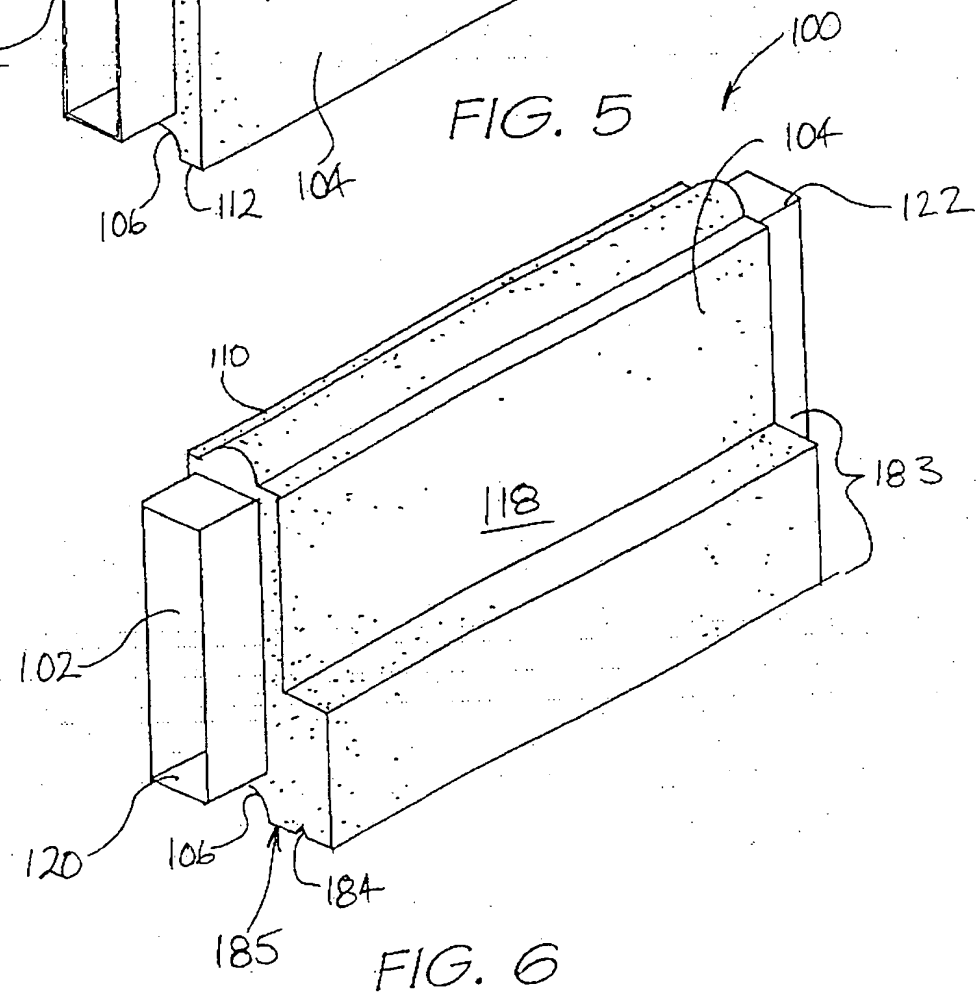

100
104
122
110
183
118
102
120
106
184
185

FIG. 6

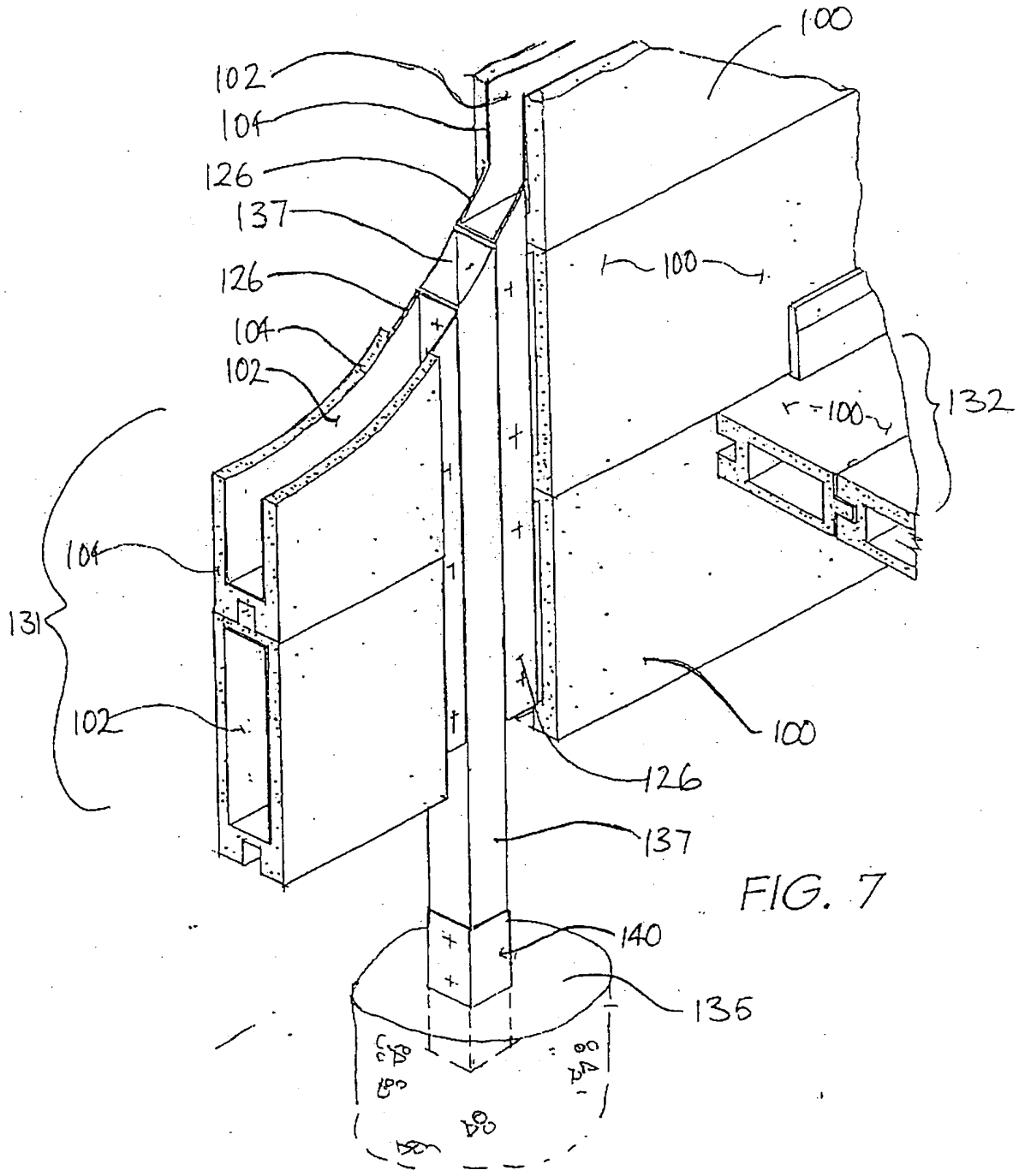

100
102
104
126
137
126
104
102
100
132
104
131
102
100
126
137
140
135

FIG. 7

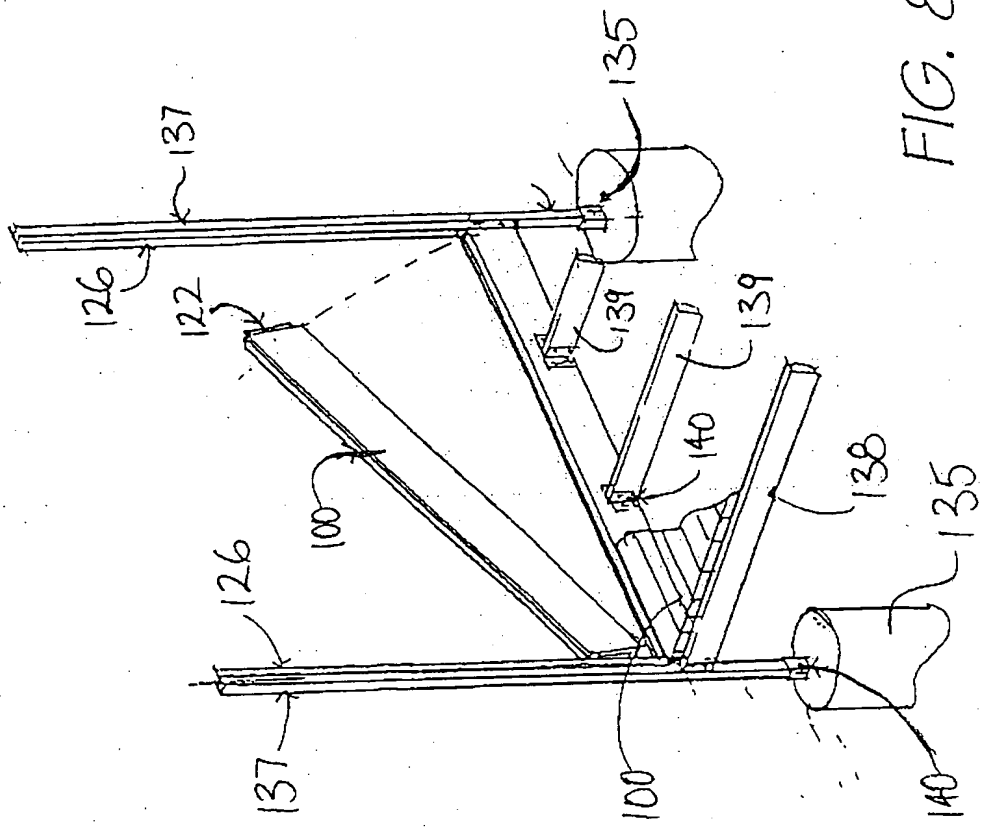



FIG. 8

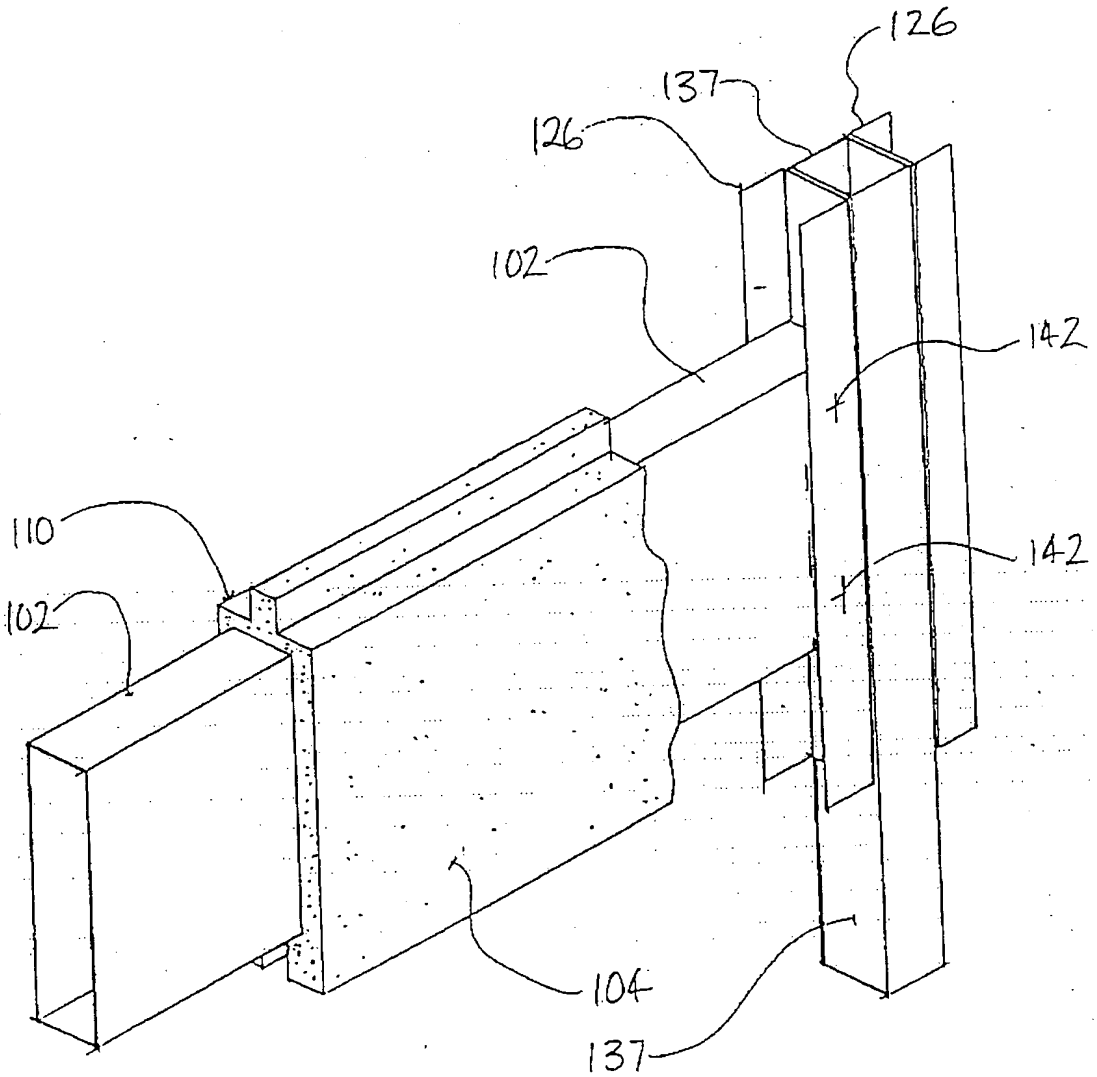



FIG. 9

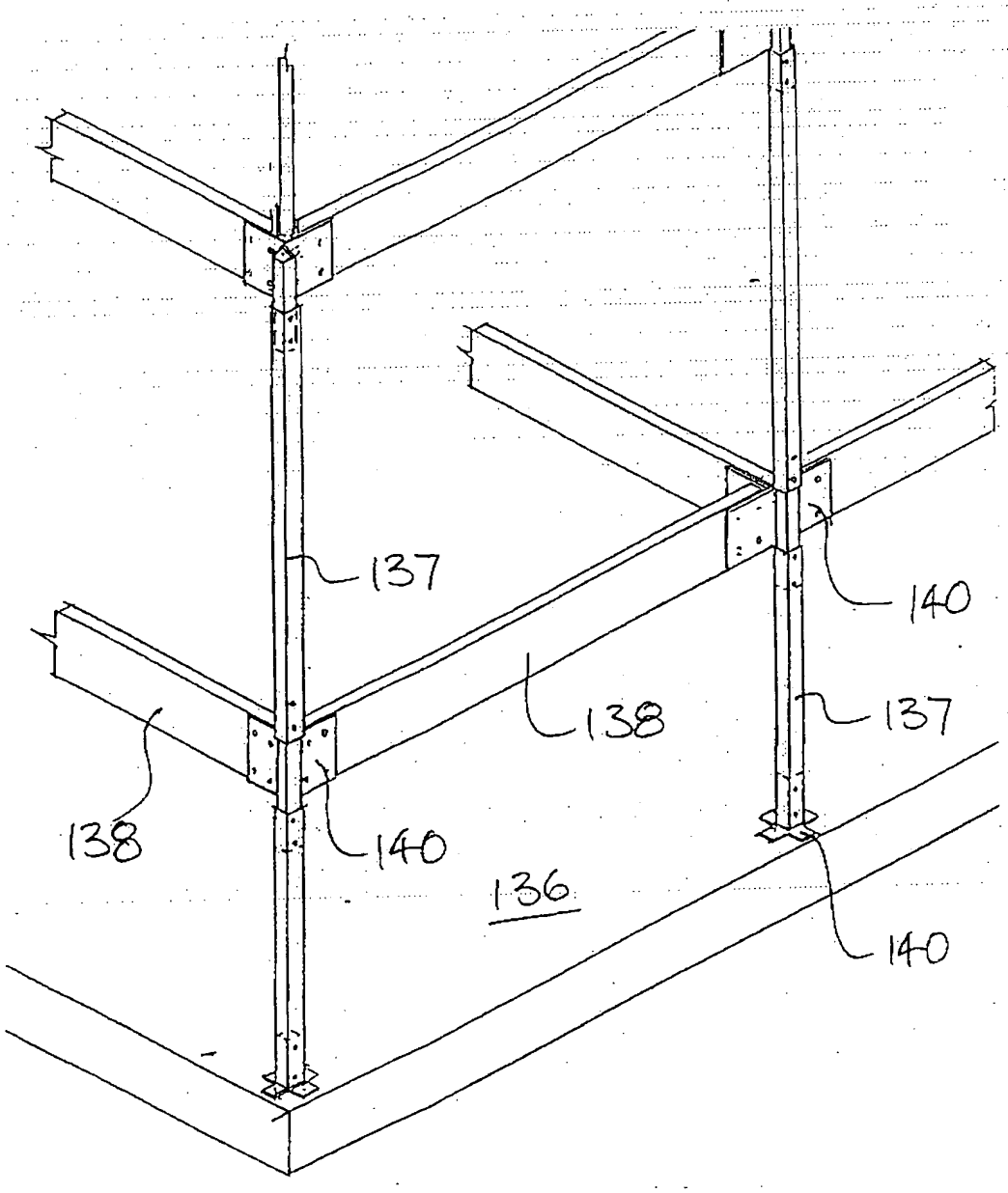



FIG. 10

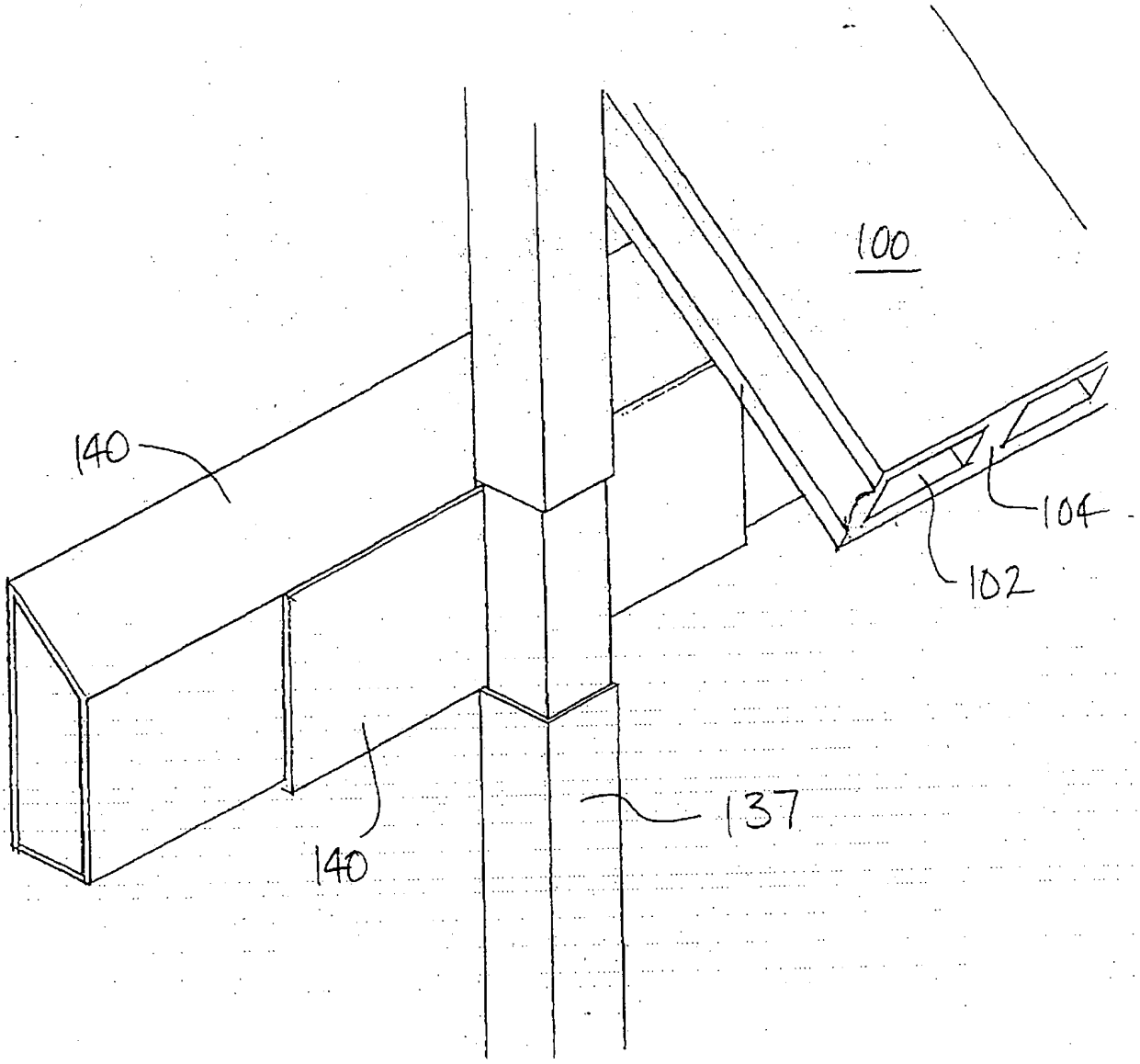



FIG. 11

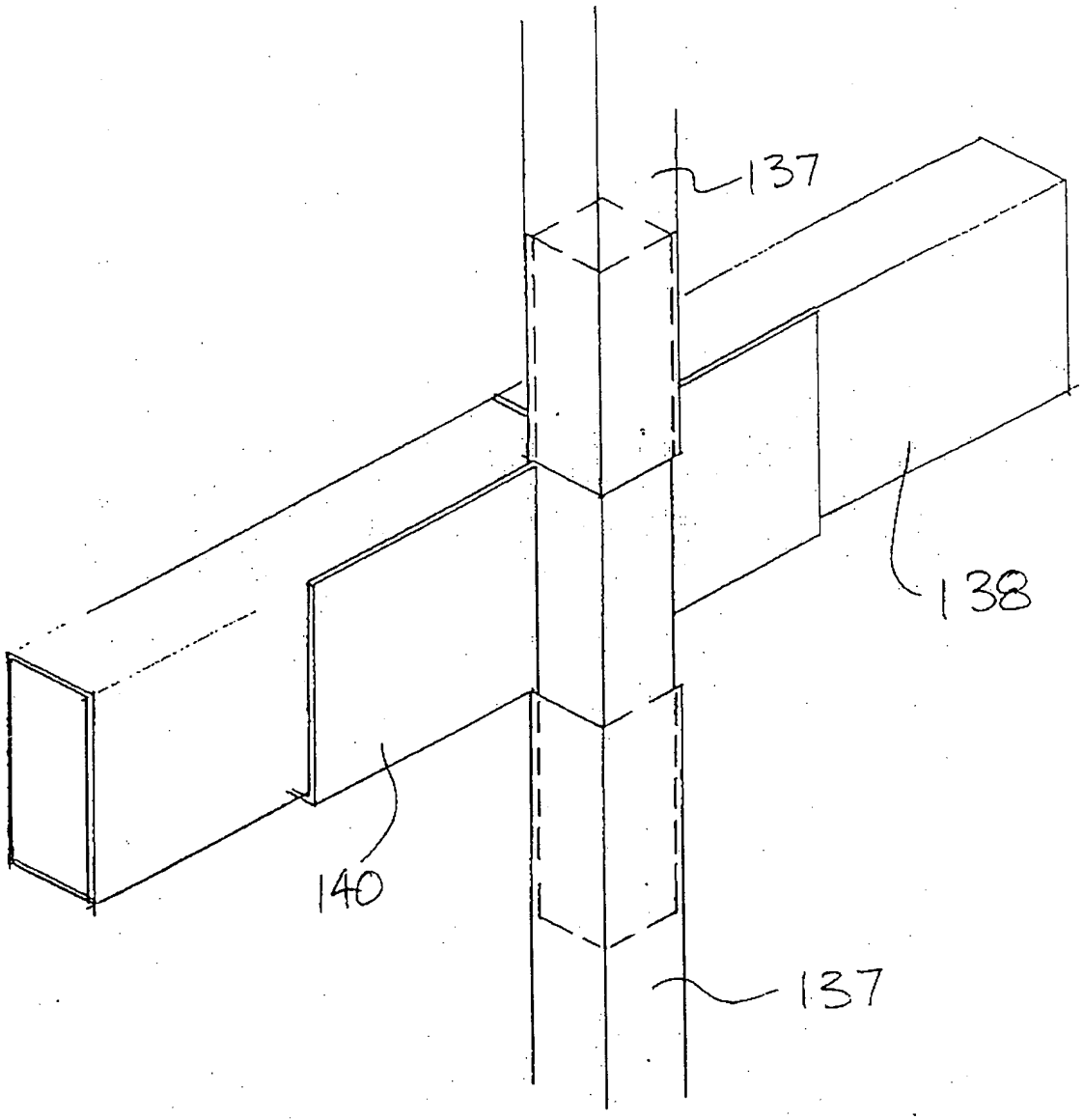



FIG. 12

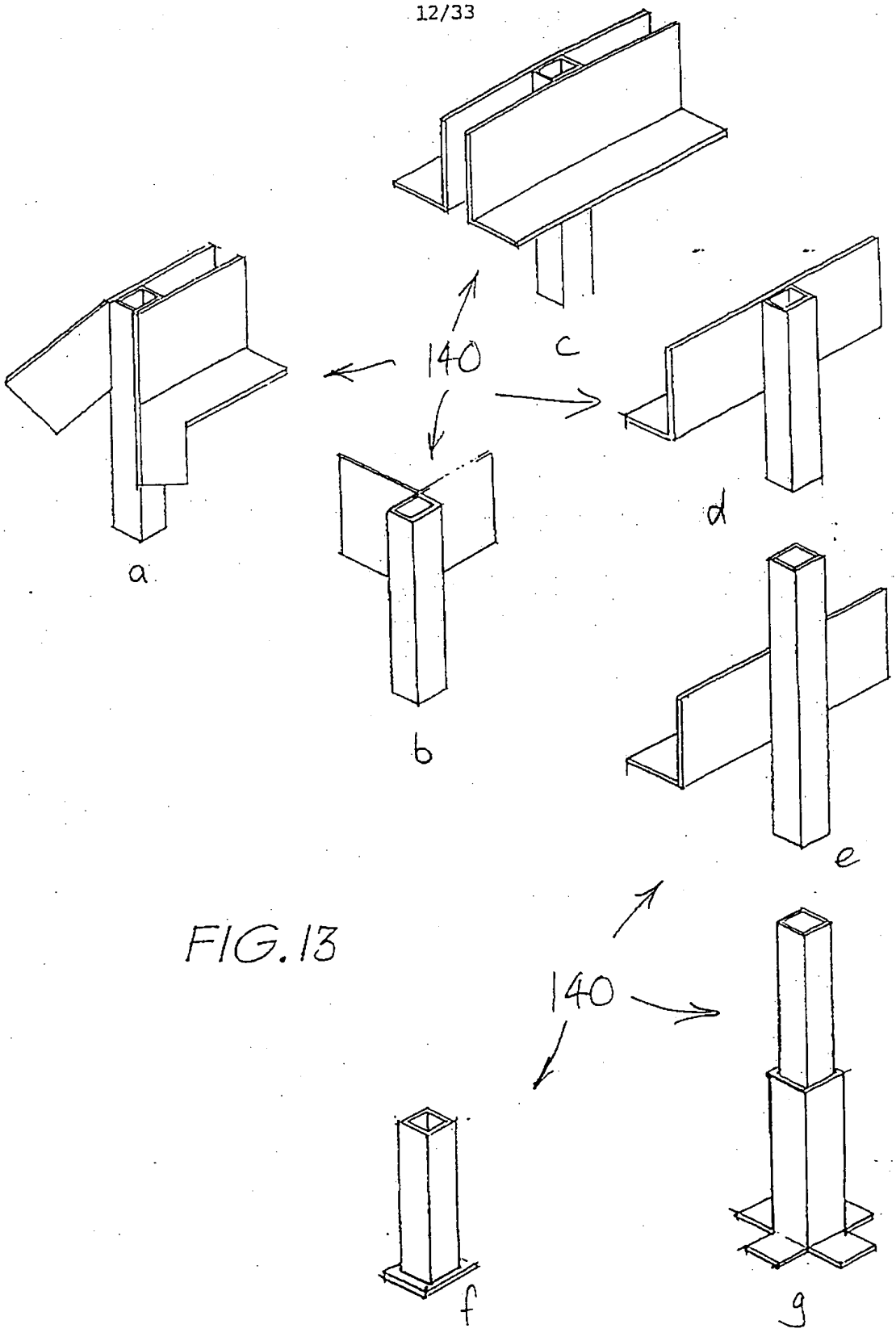



FIG. 13

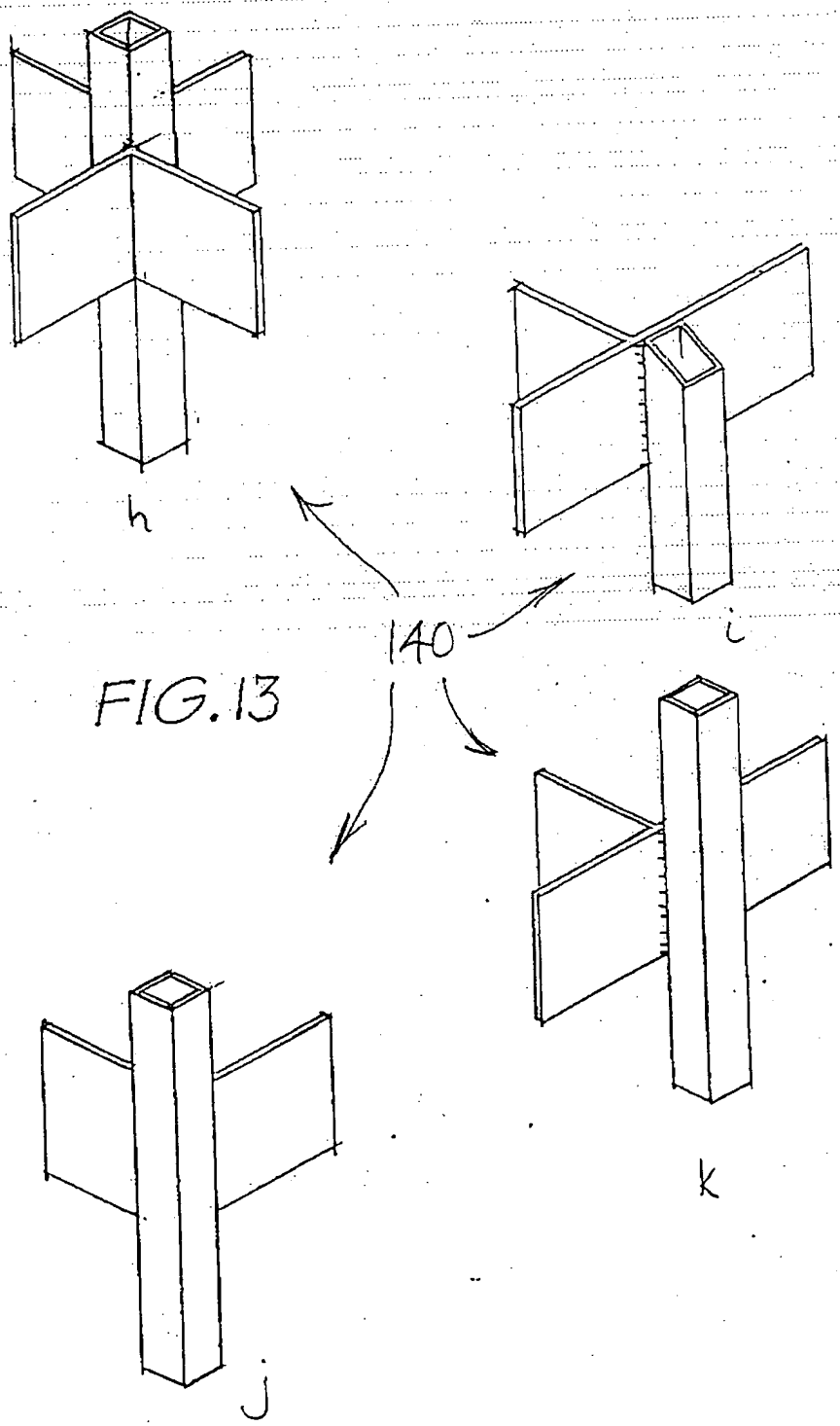



FIG. 13

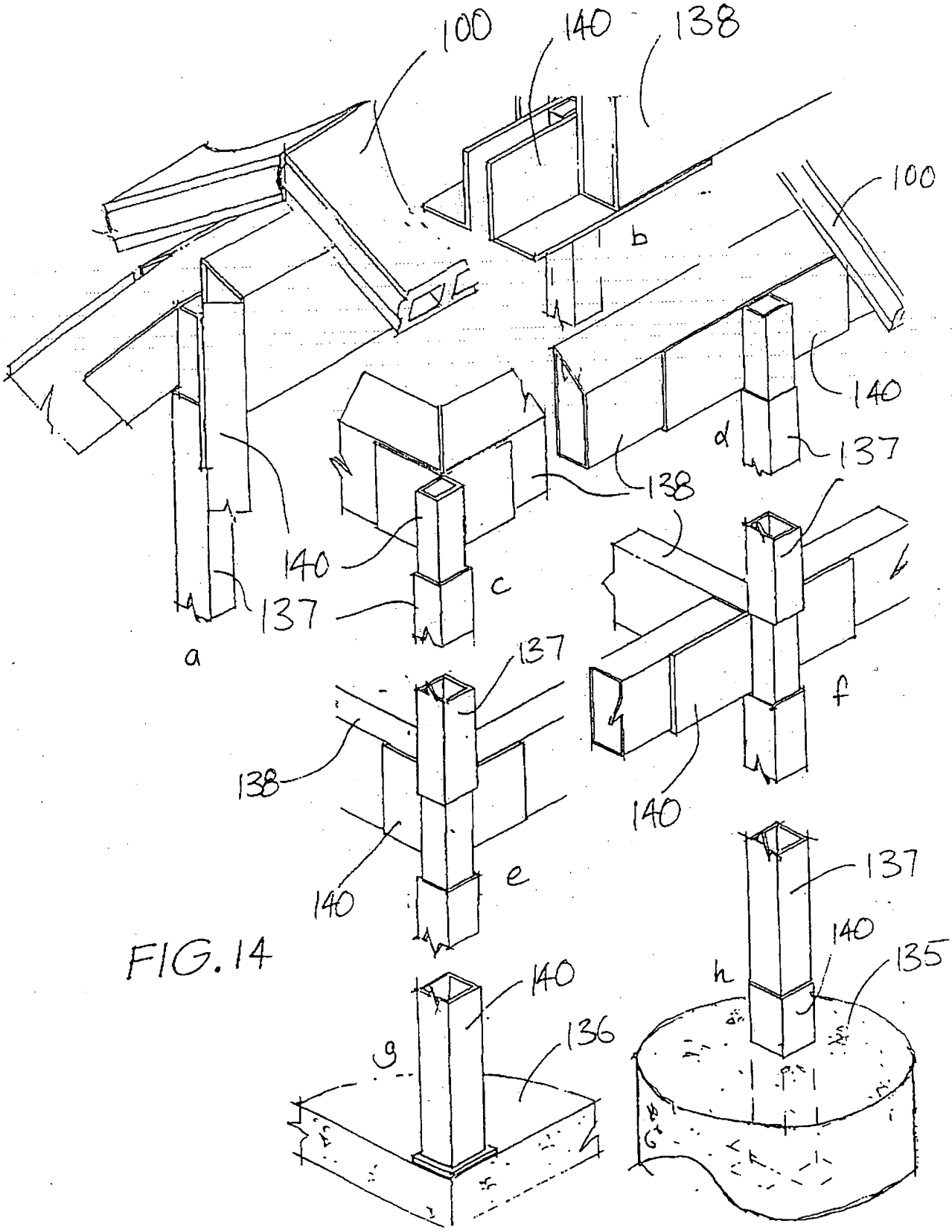

100
140
138
100
b
140
d
137
138
140
137
c
a
137
138
f
140
137
140
e
137
140
h
135
140
g
136

FIG. 14

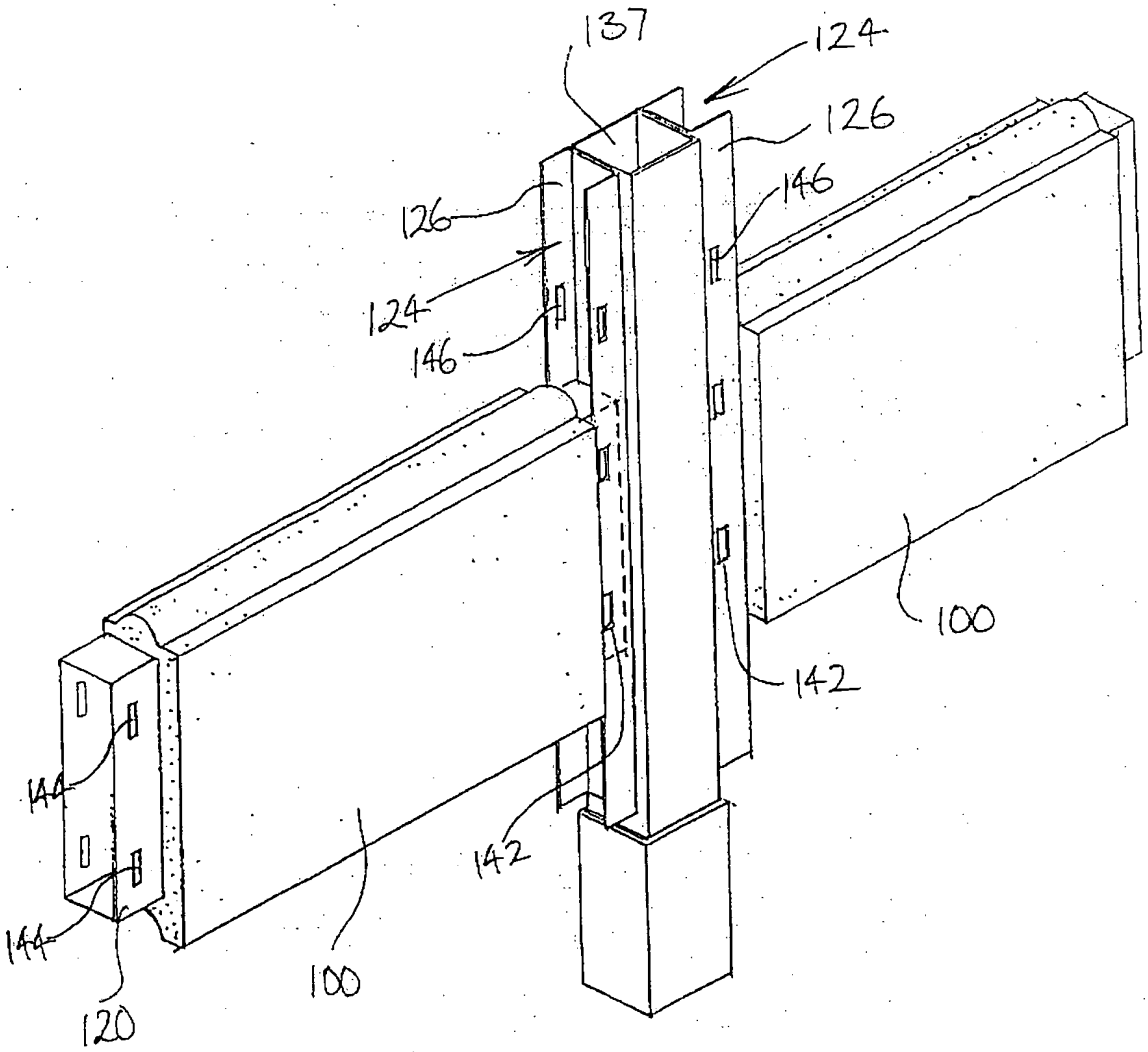



FIG. 15

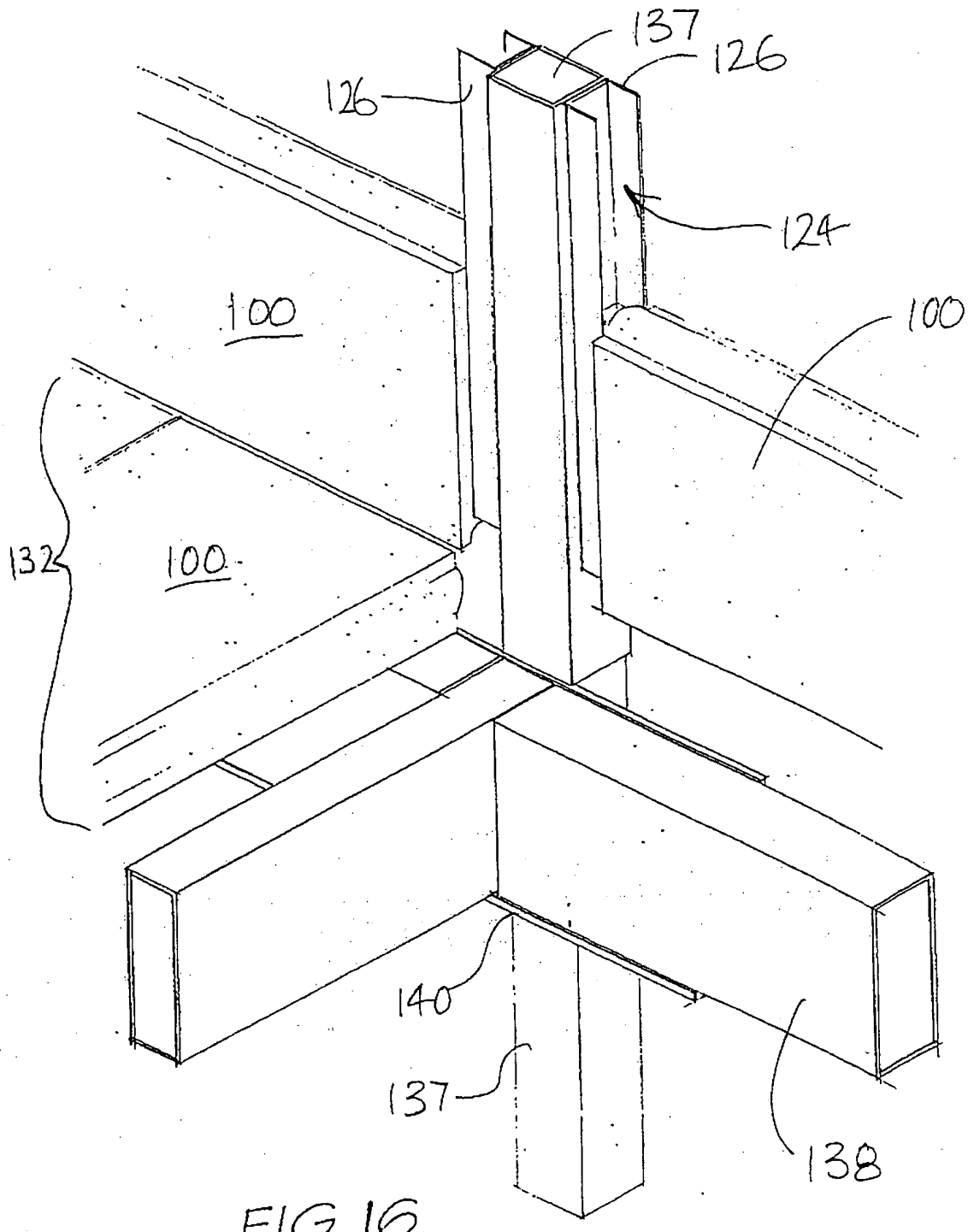



FIG. 16

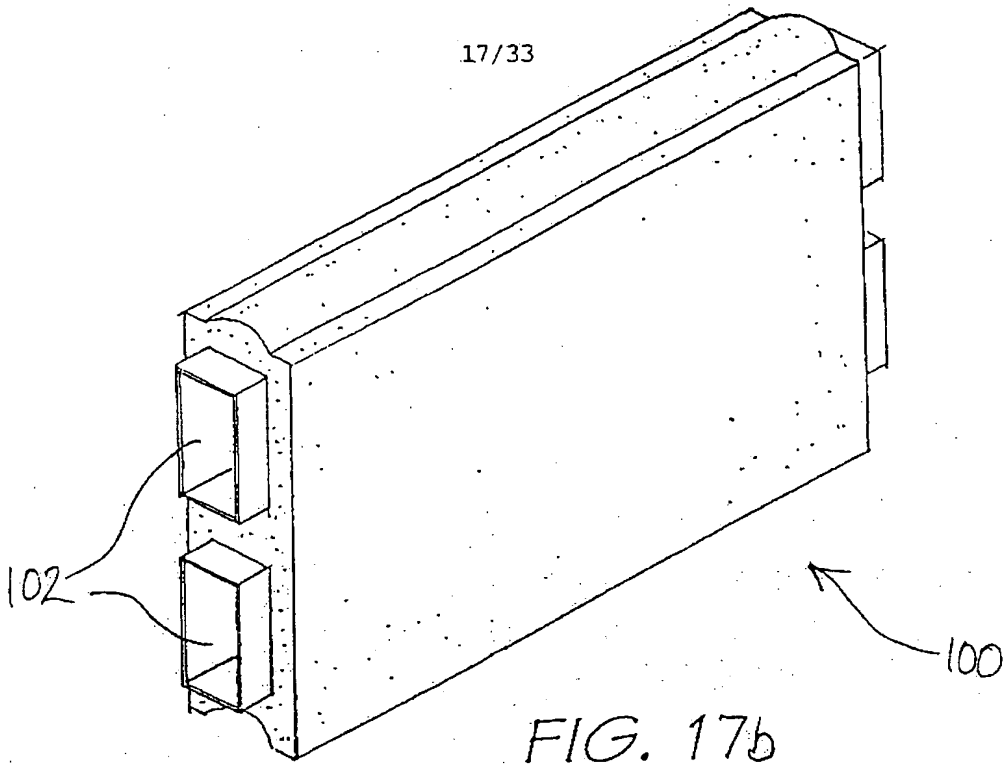



FIG. 17b

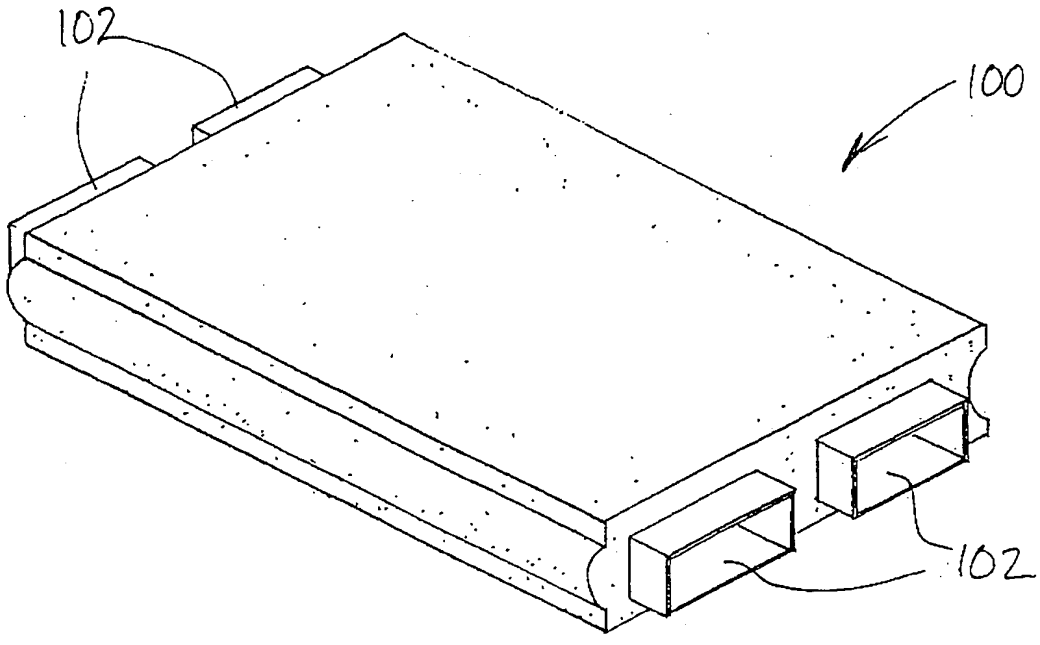



FIG. 17a

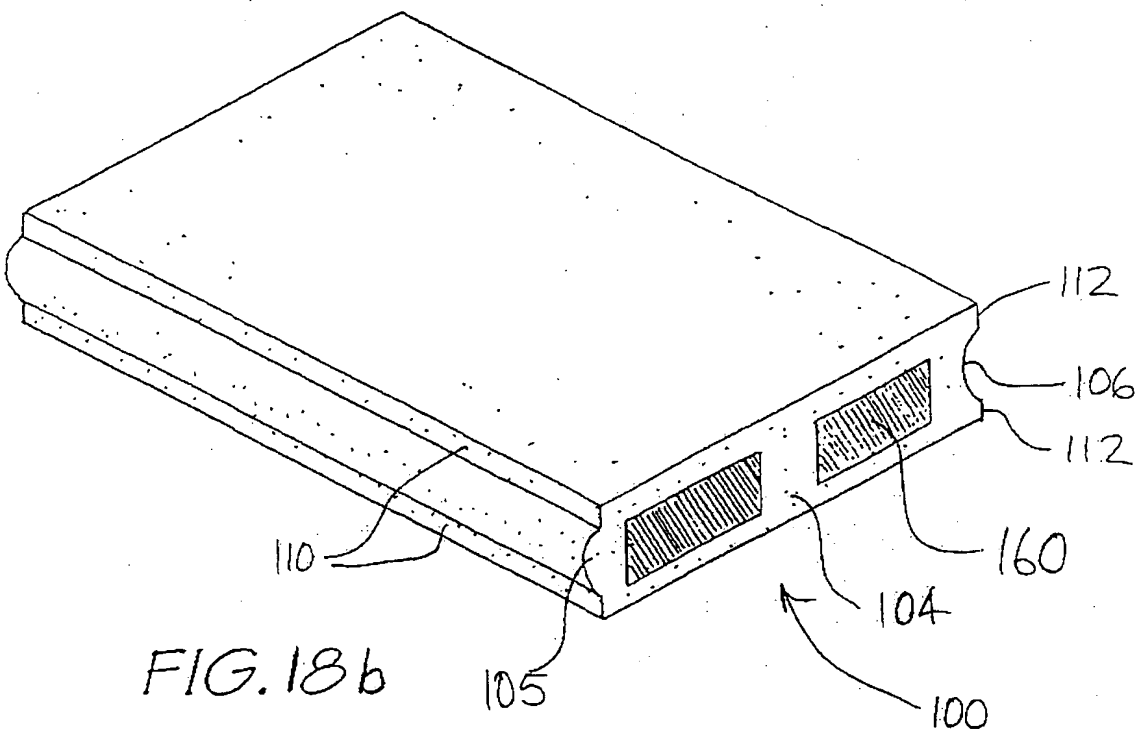



FIG. 18b

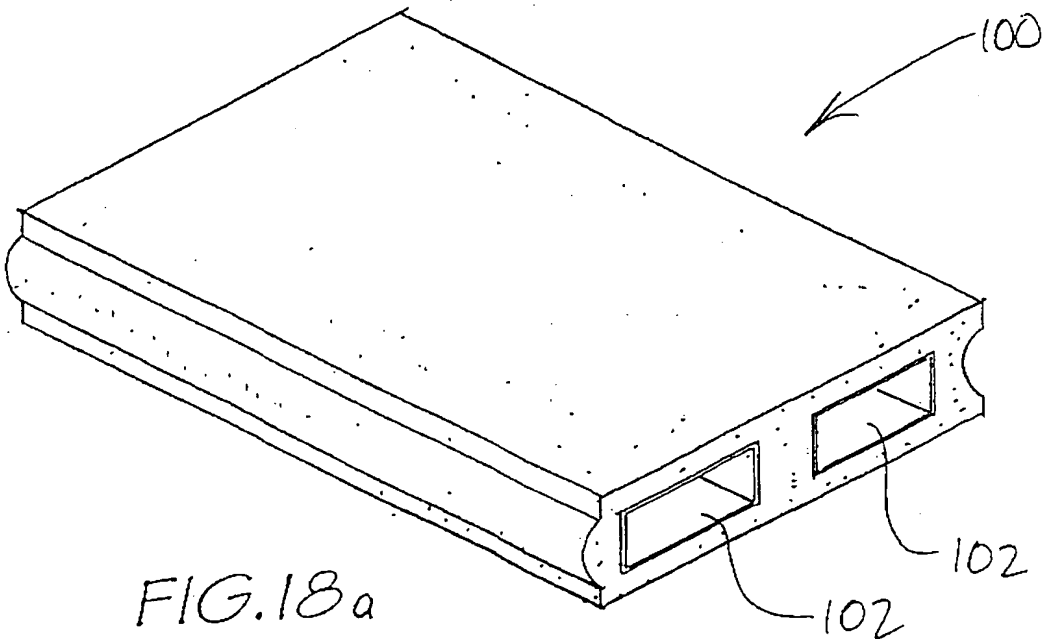



FIG. 18a

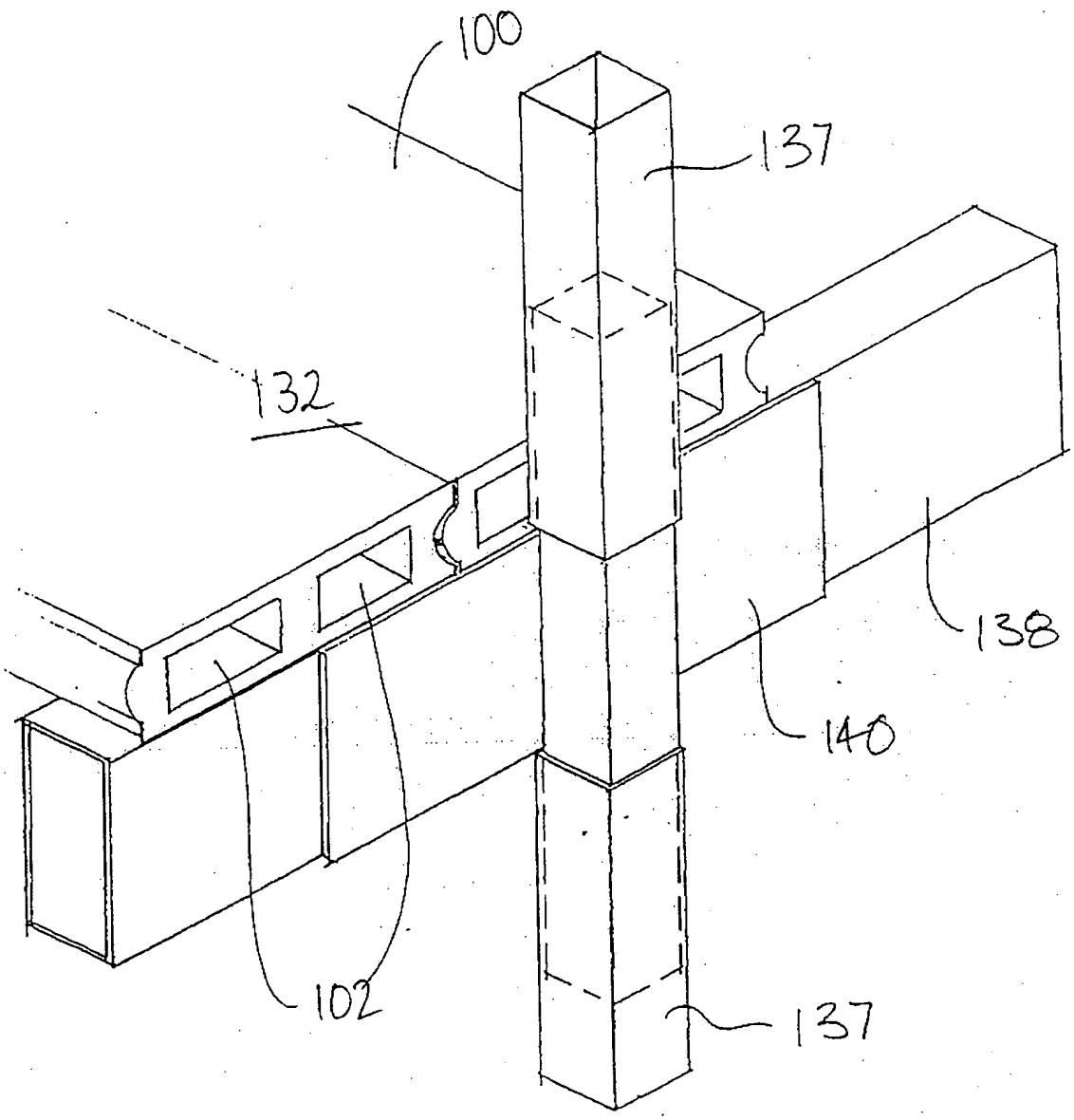



FIG.19

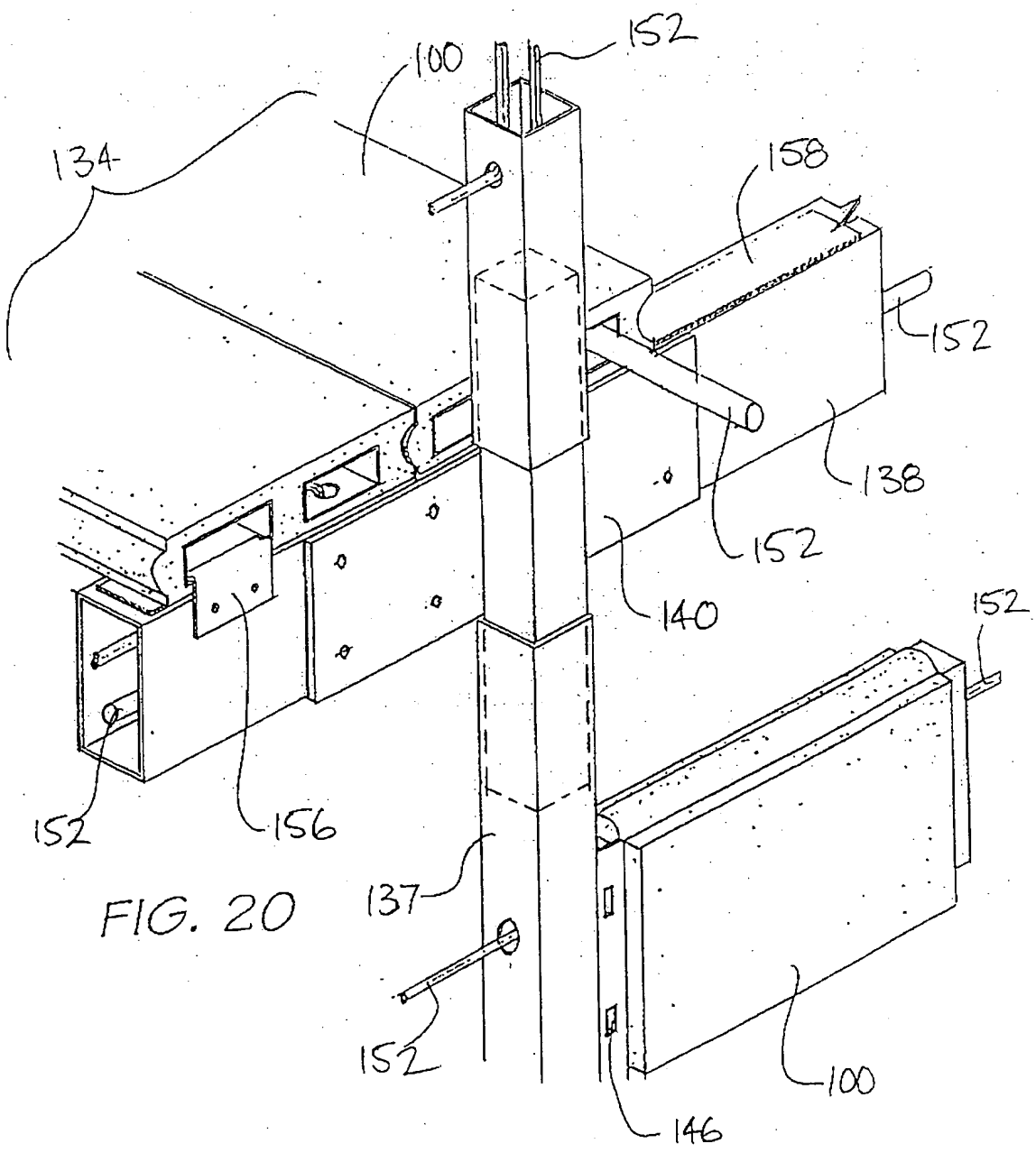



FIG. 20

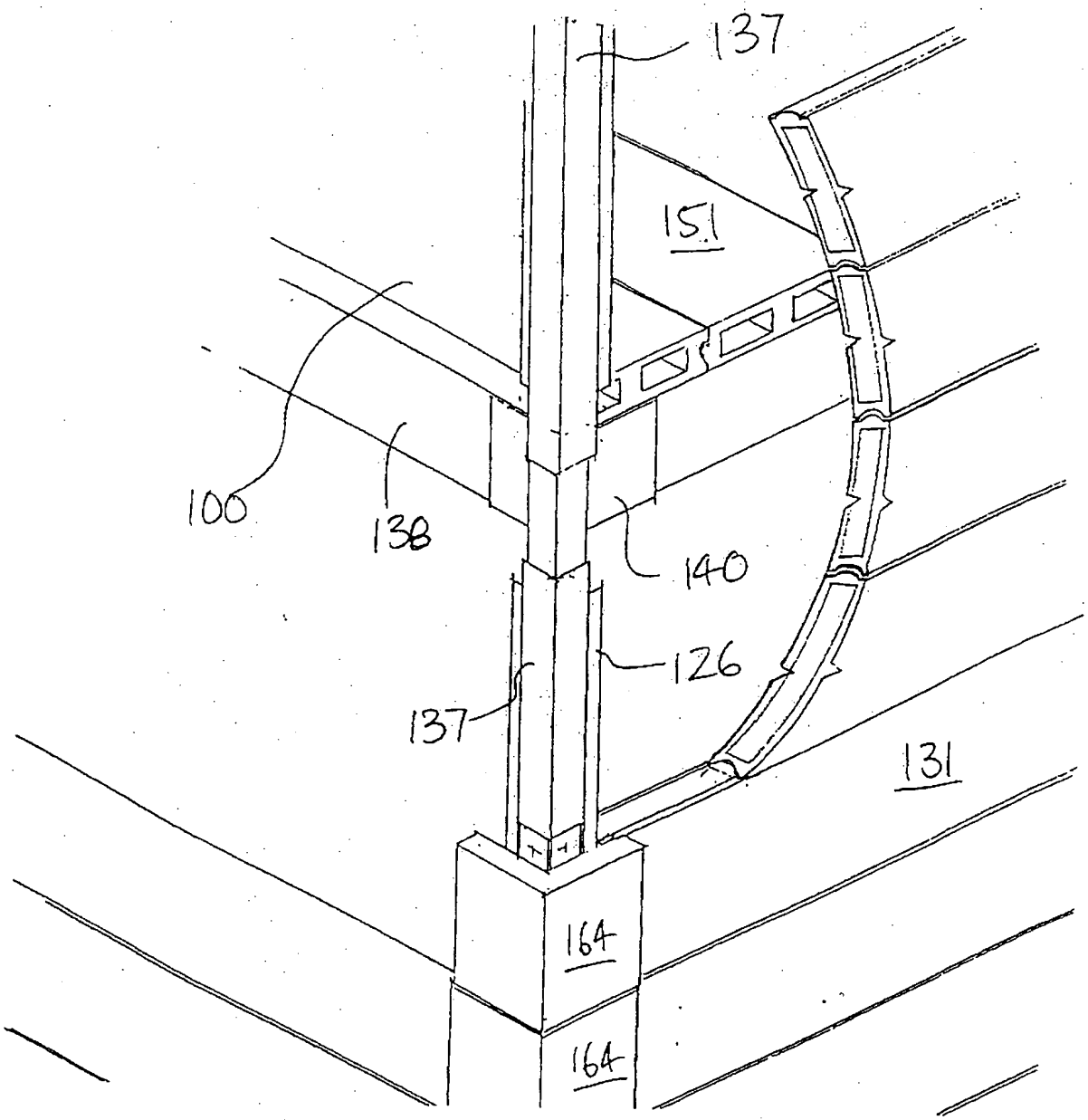



FIG. 21

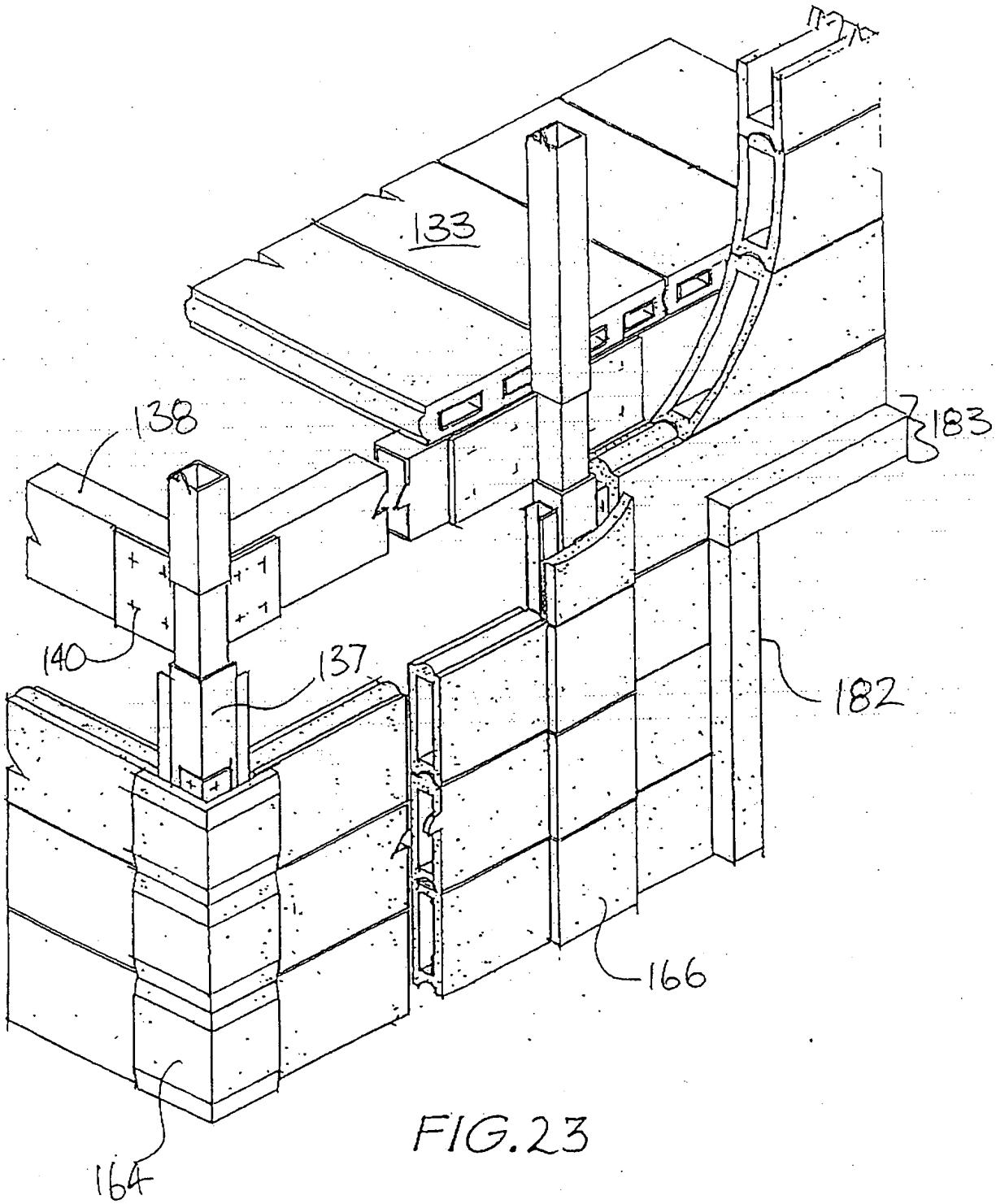



FIG.23

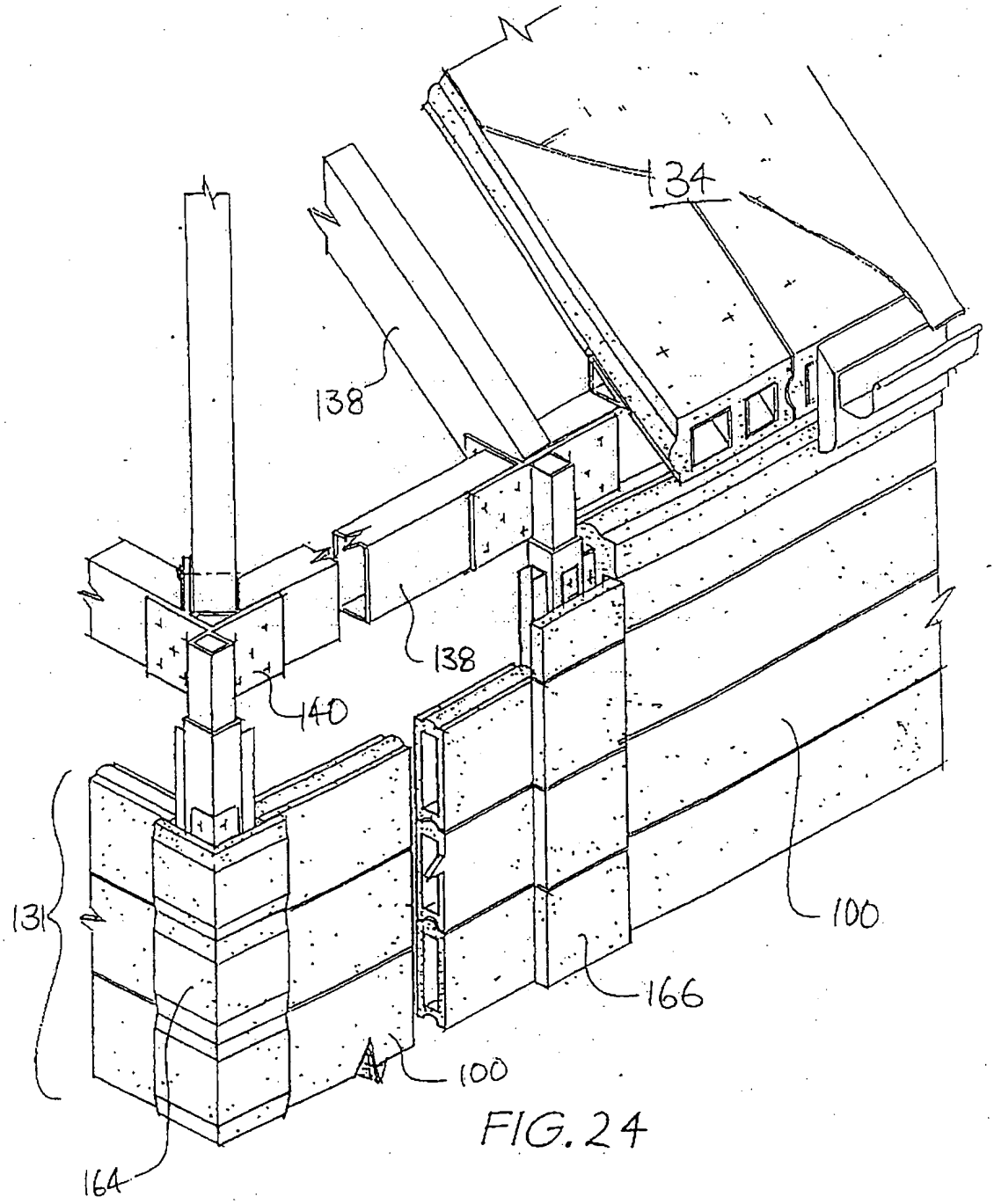
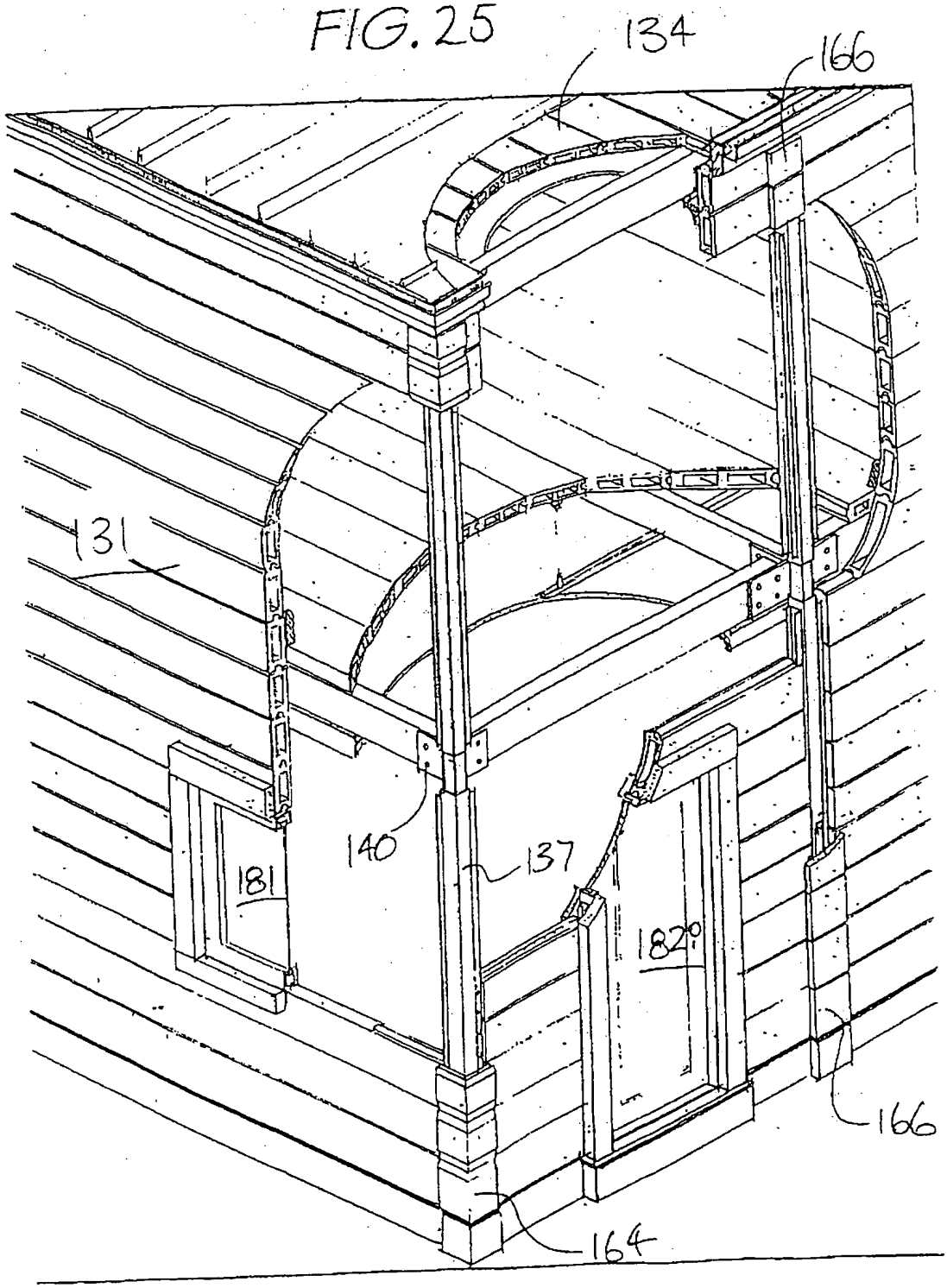



FIG. 24

FIG. 25



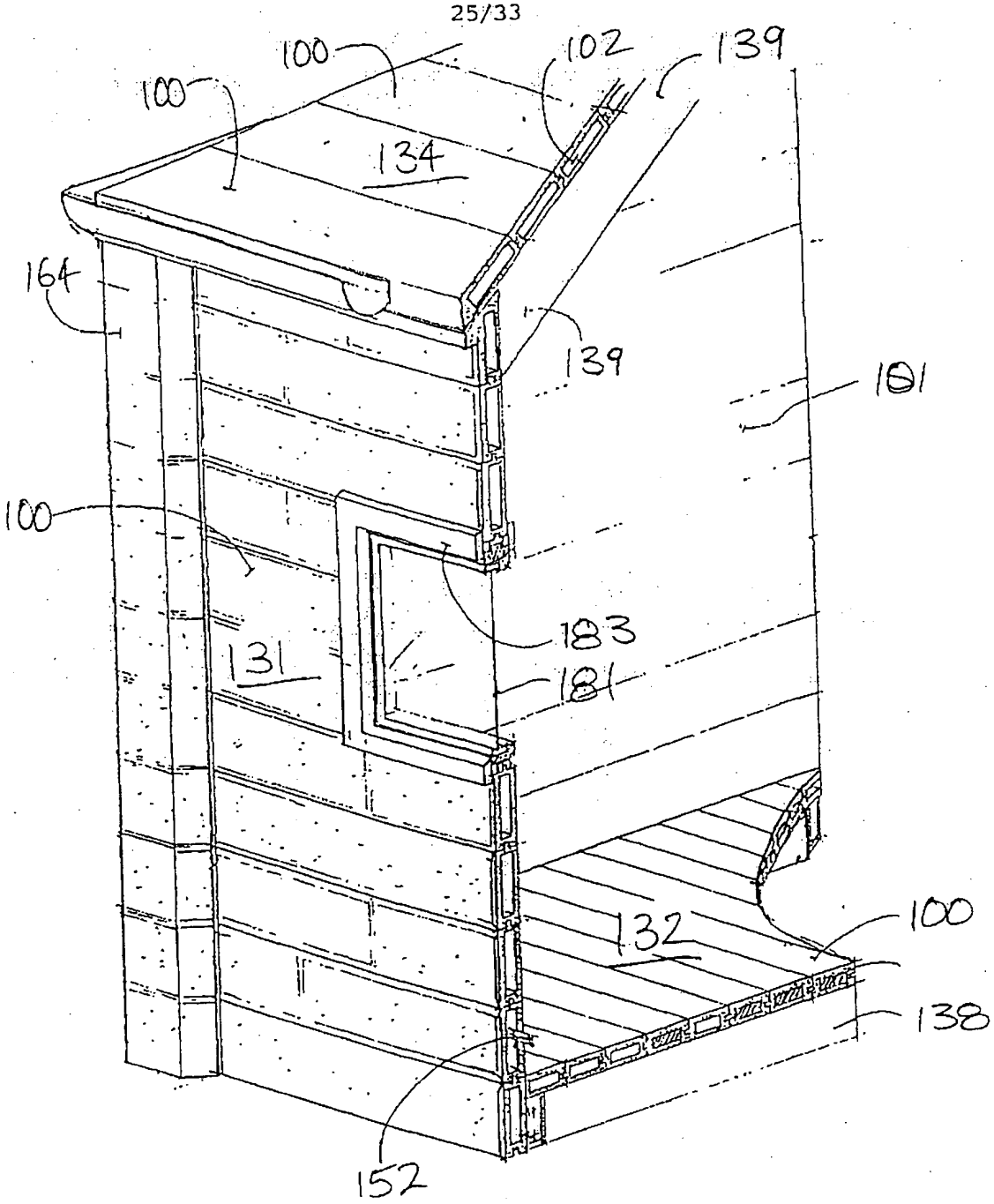



FIG. 26

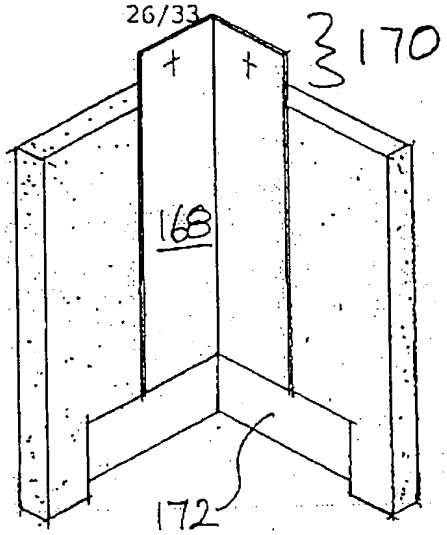



FIG. 27

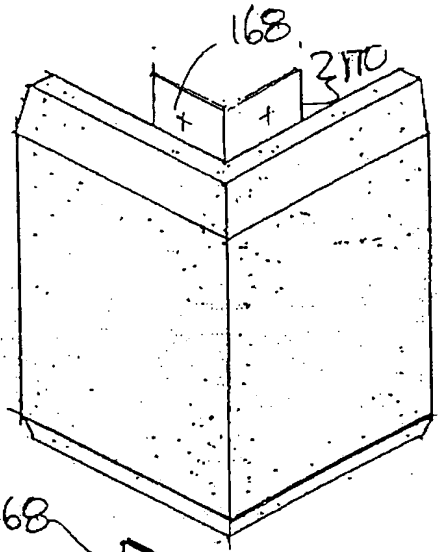



FIG. 28

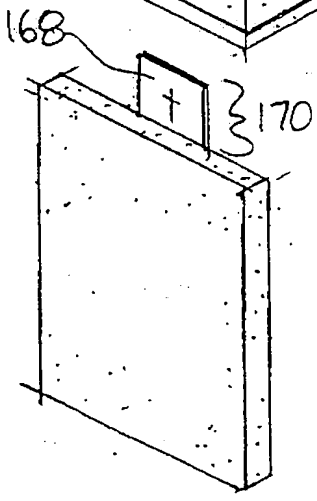



FIG. 30

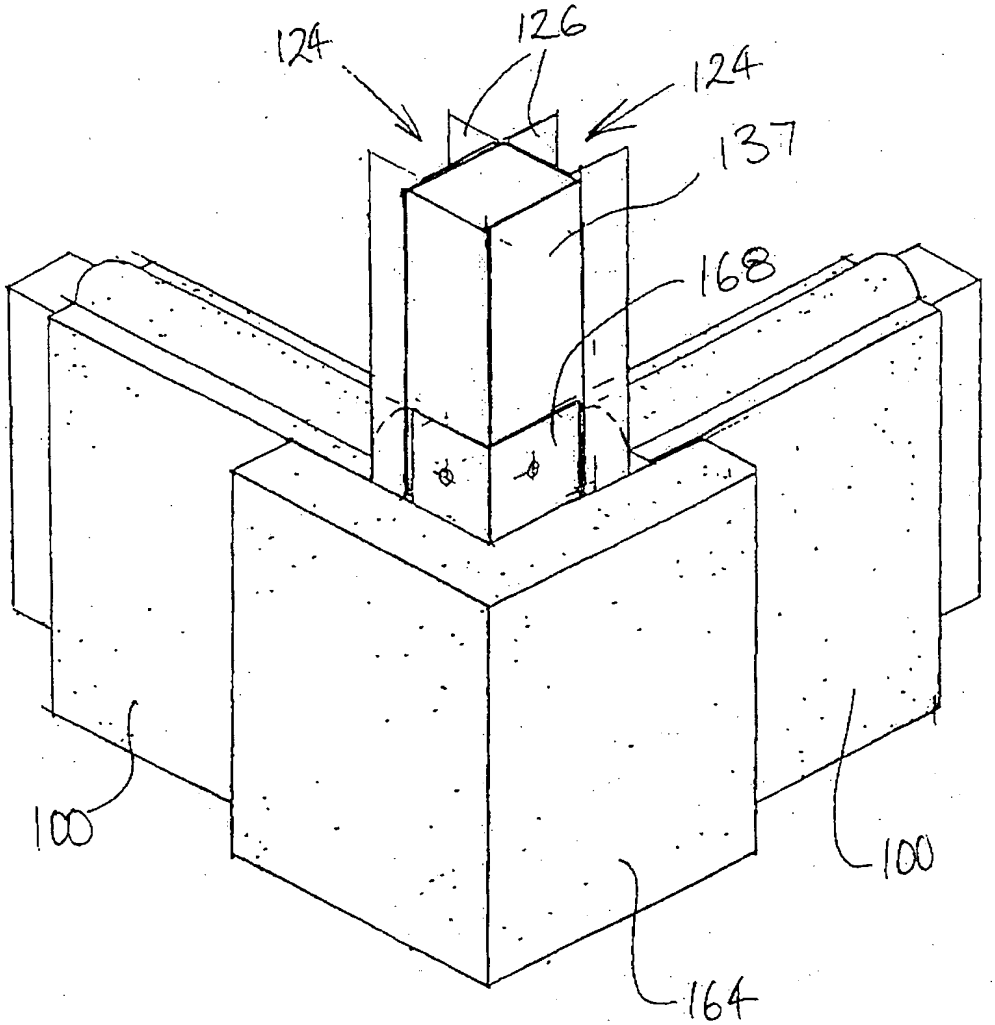



FIG. 29

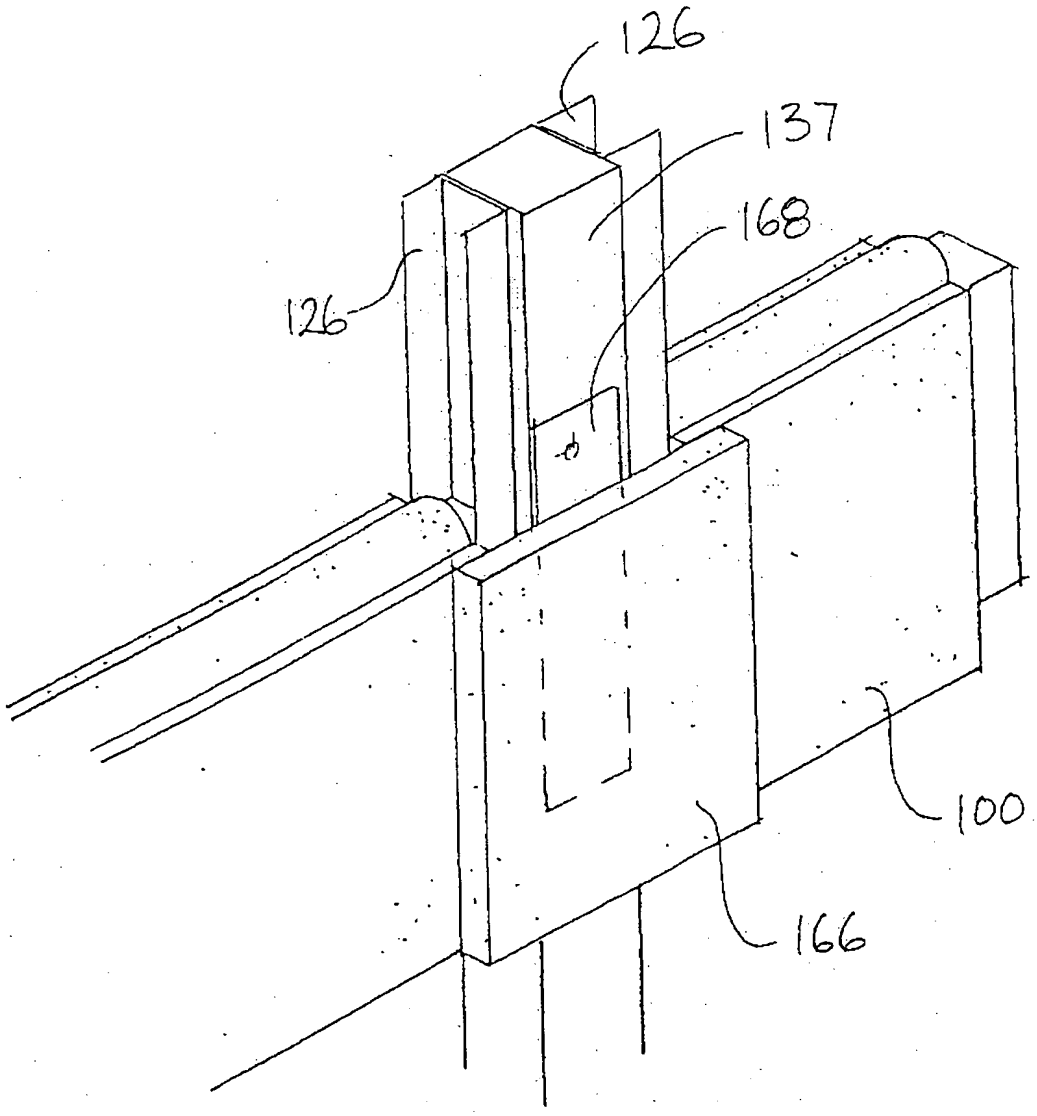



FIG. 31

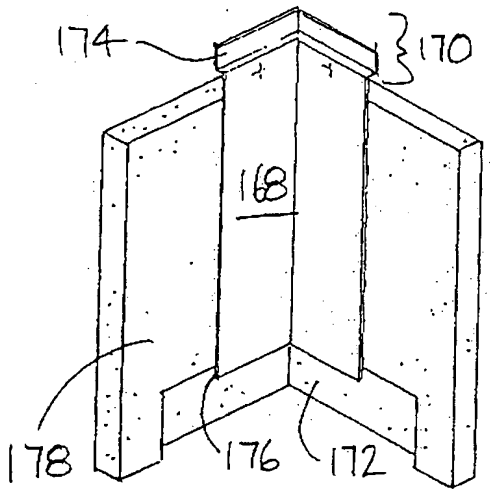



FIG.32

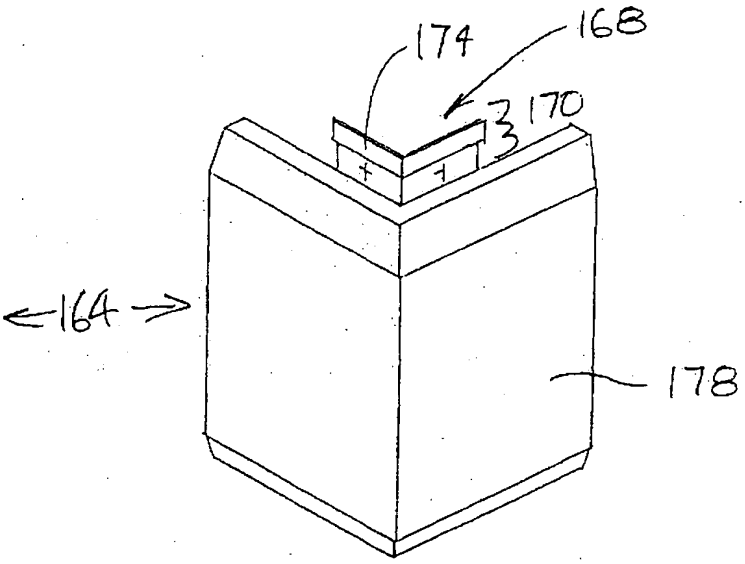



FIG.33

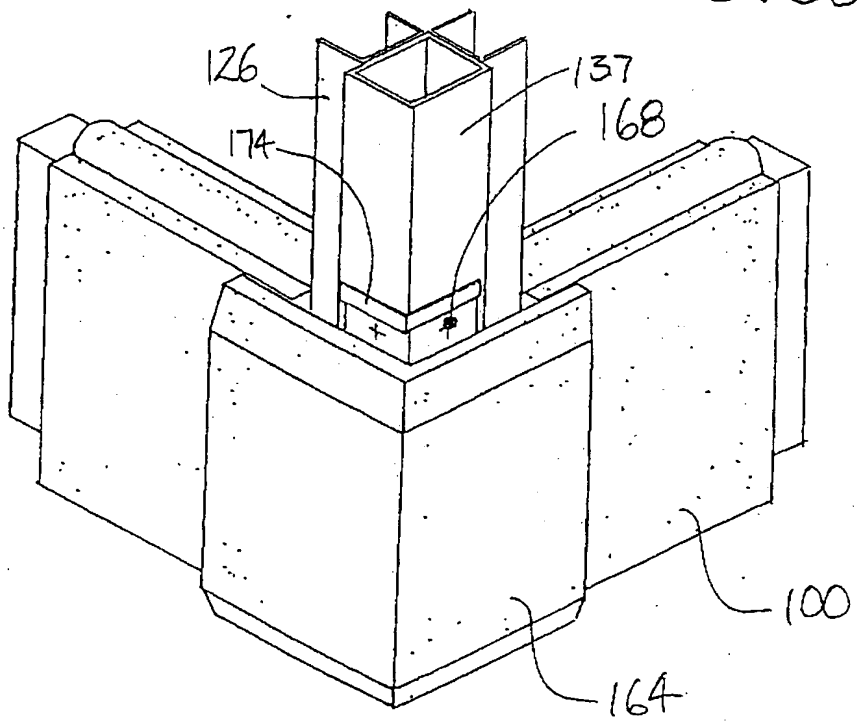



FIG.34

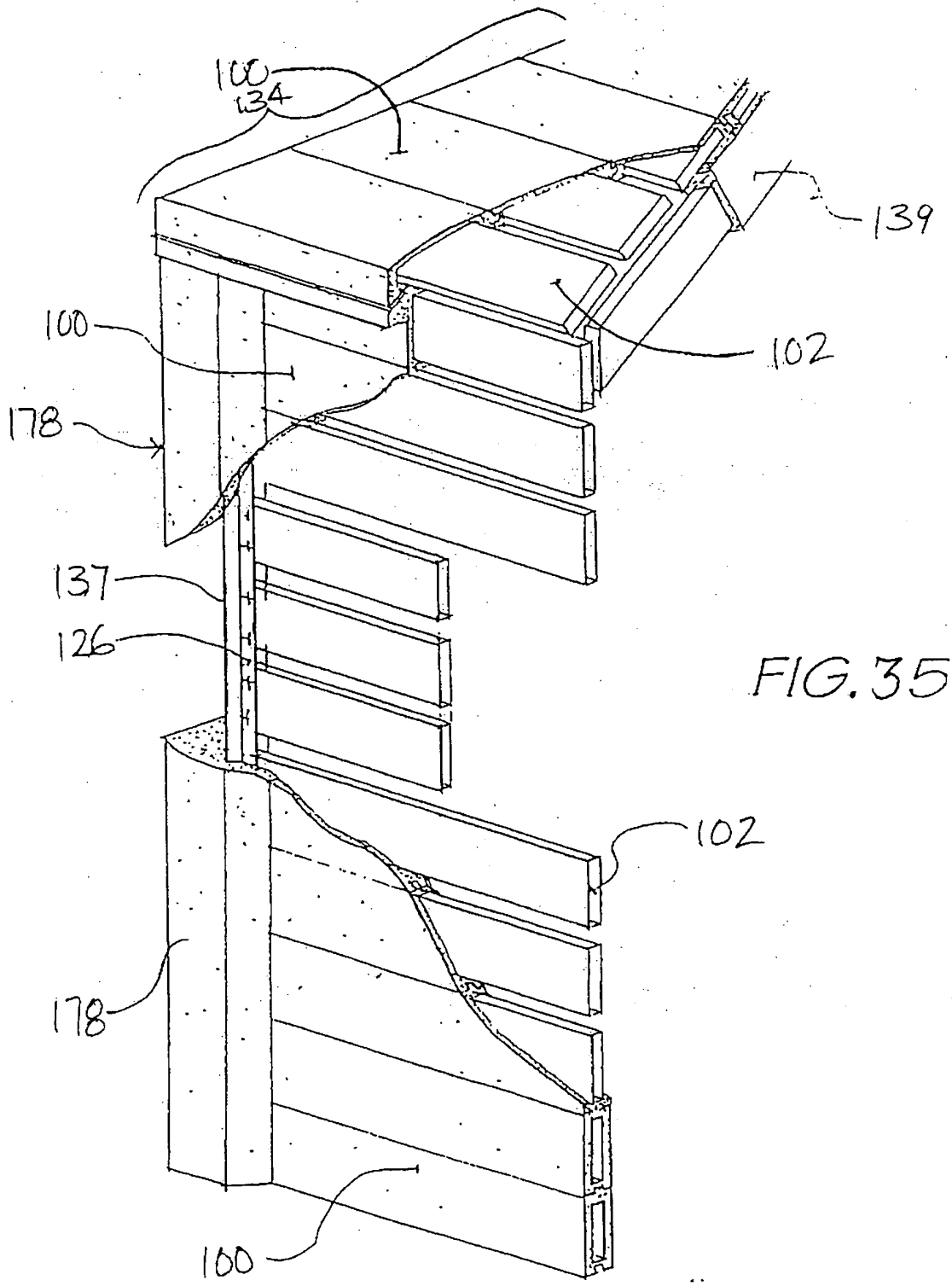



FIG. 35

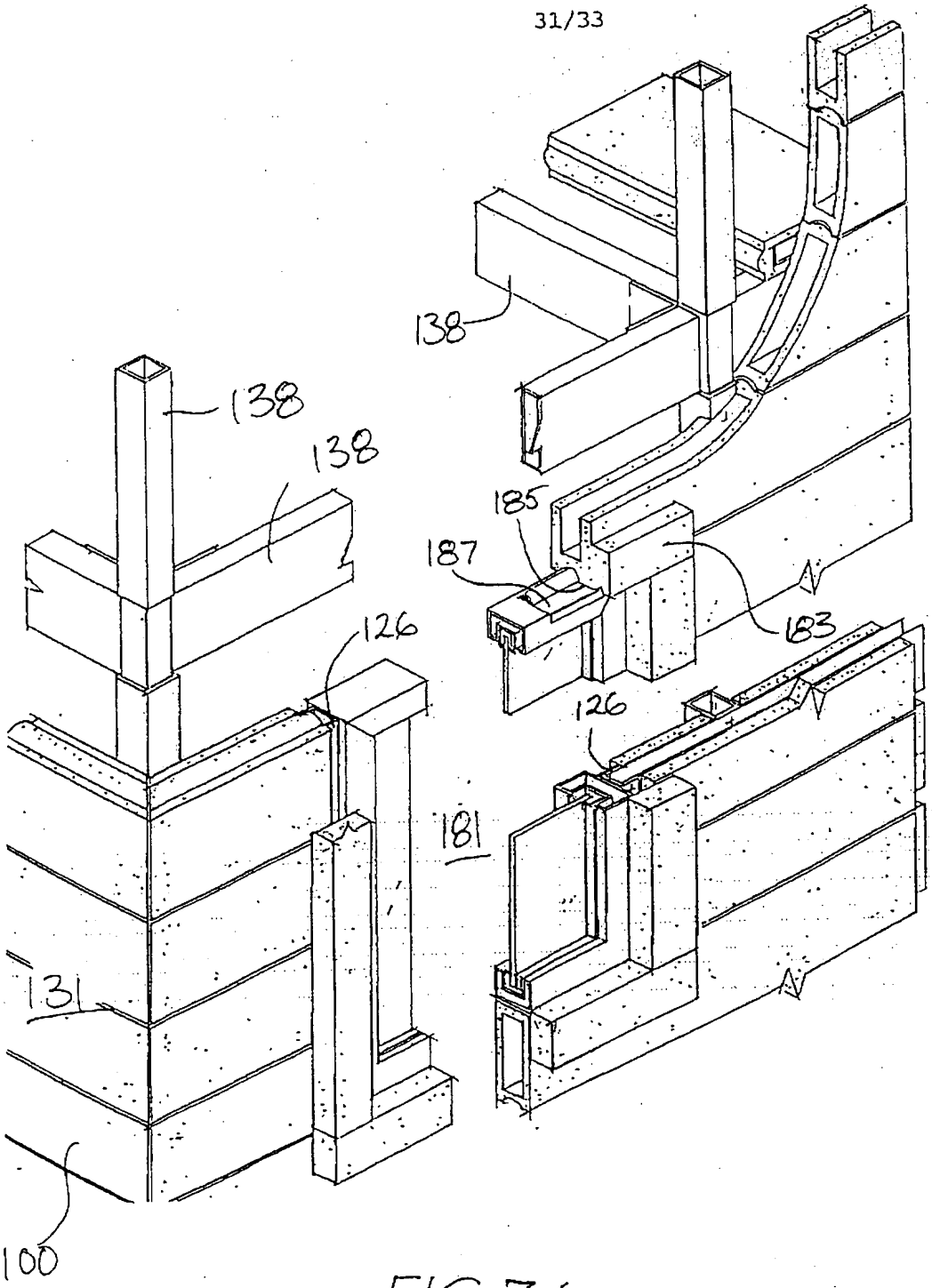



FIG.36

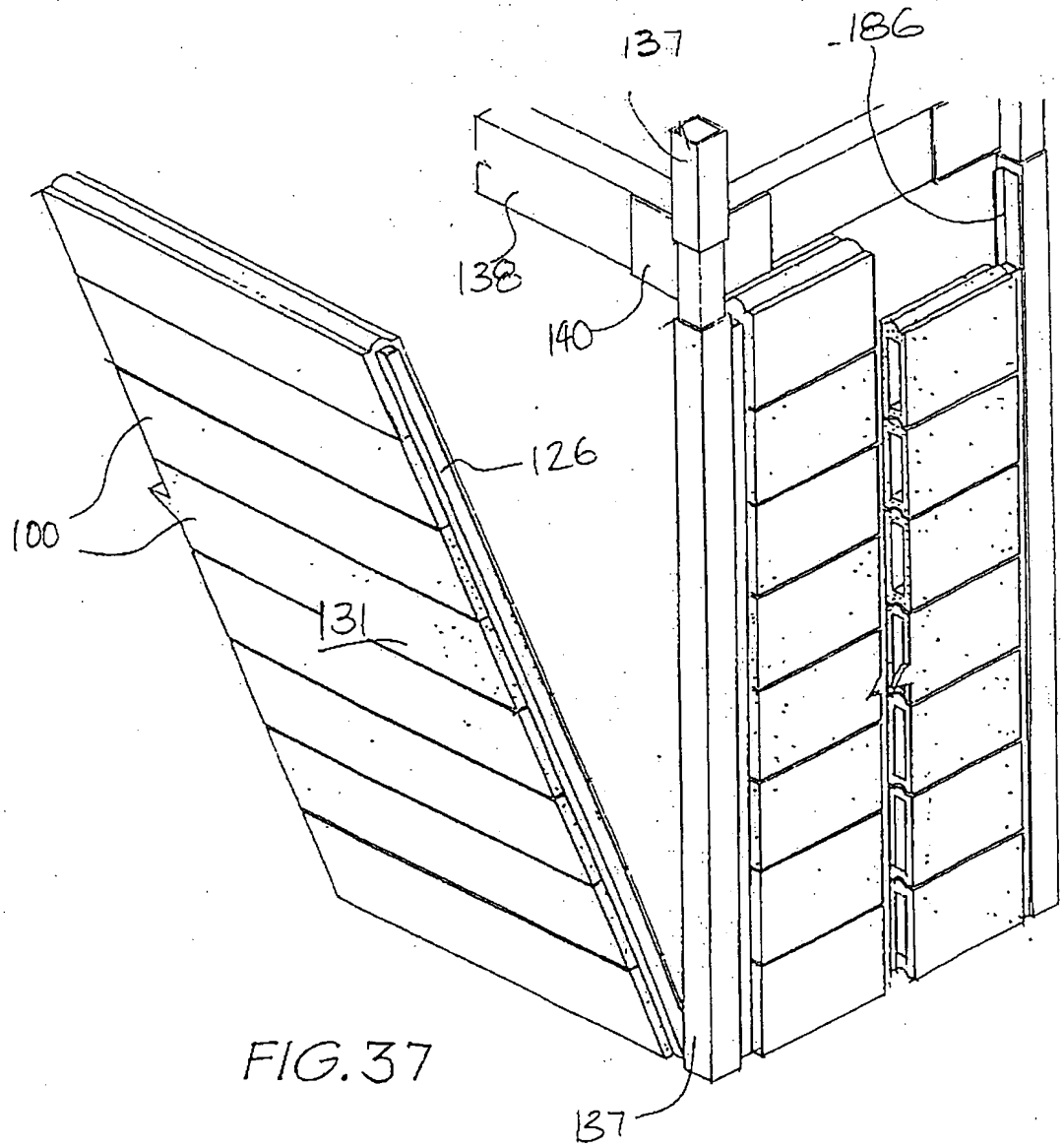



FIG. 37

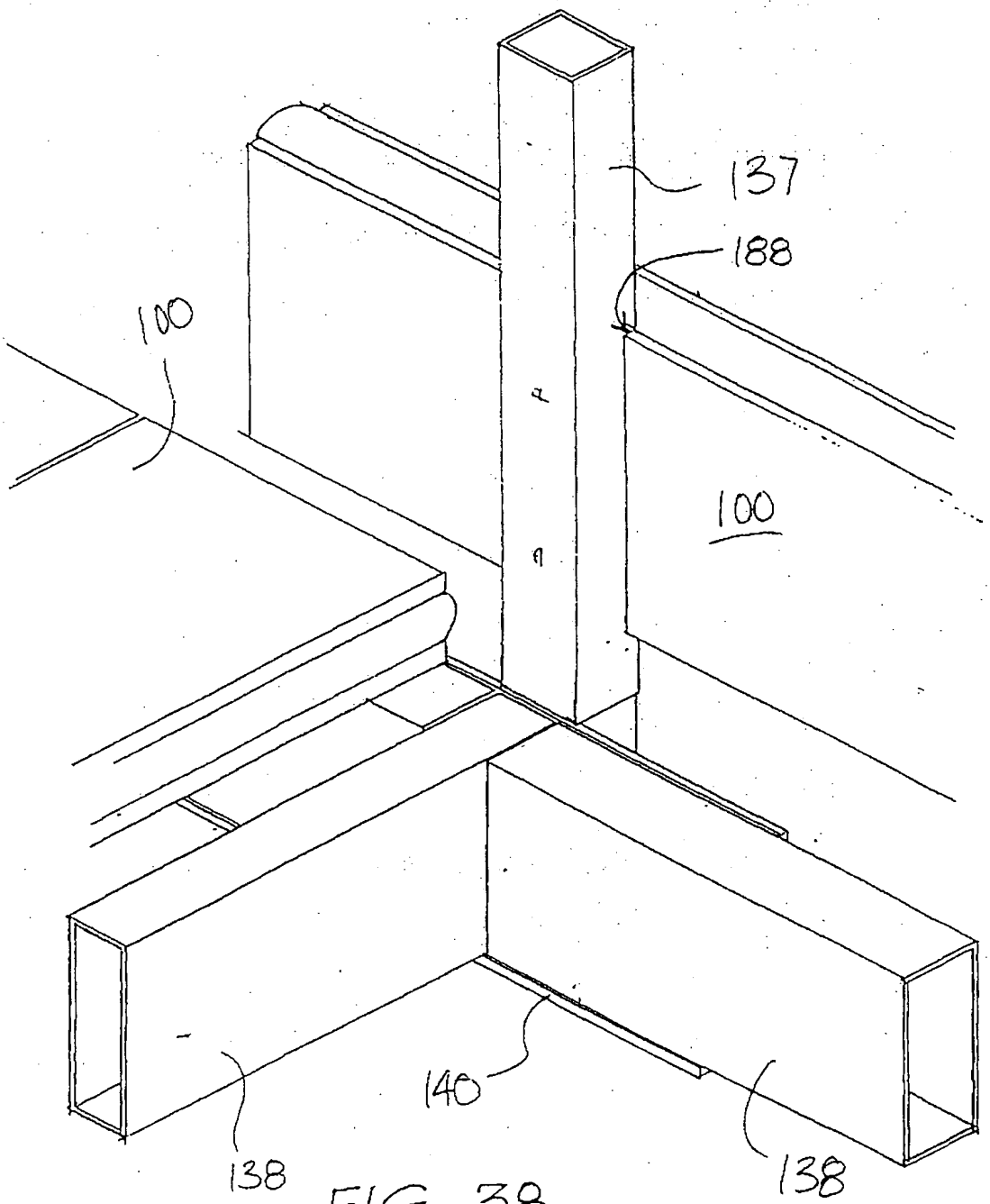



FIG. 38